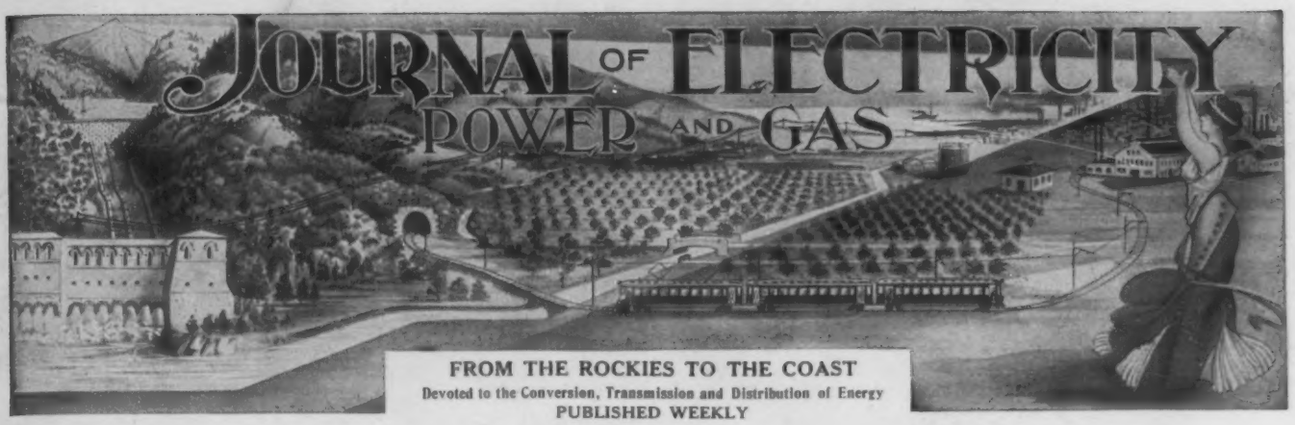
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POWER AND GAS
FROM THE ROCKIES TO THE COAST
Devoted to the Conversion, Transmission and Distribution of Energy
PUBLISHED WEEKLY

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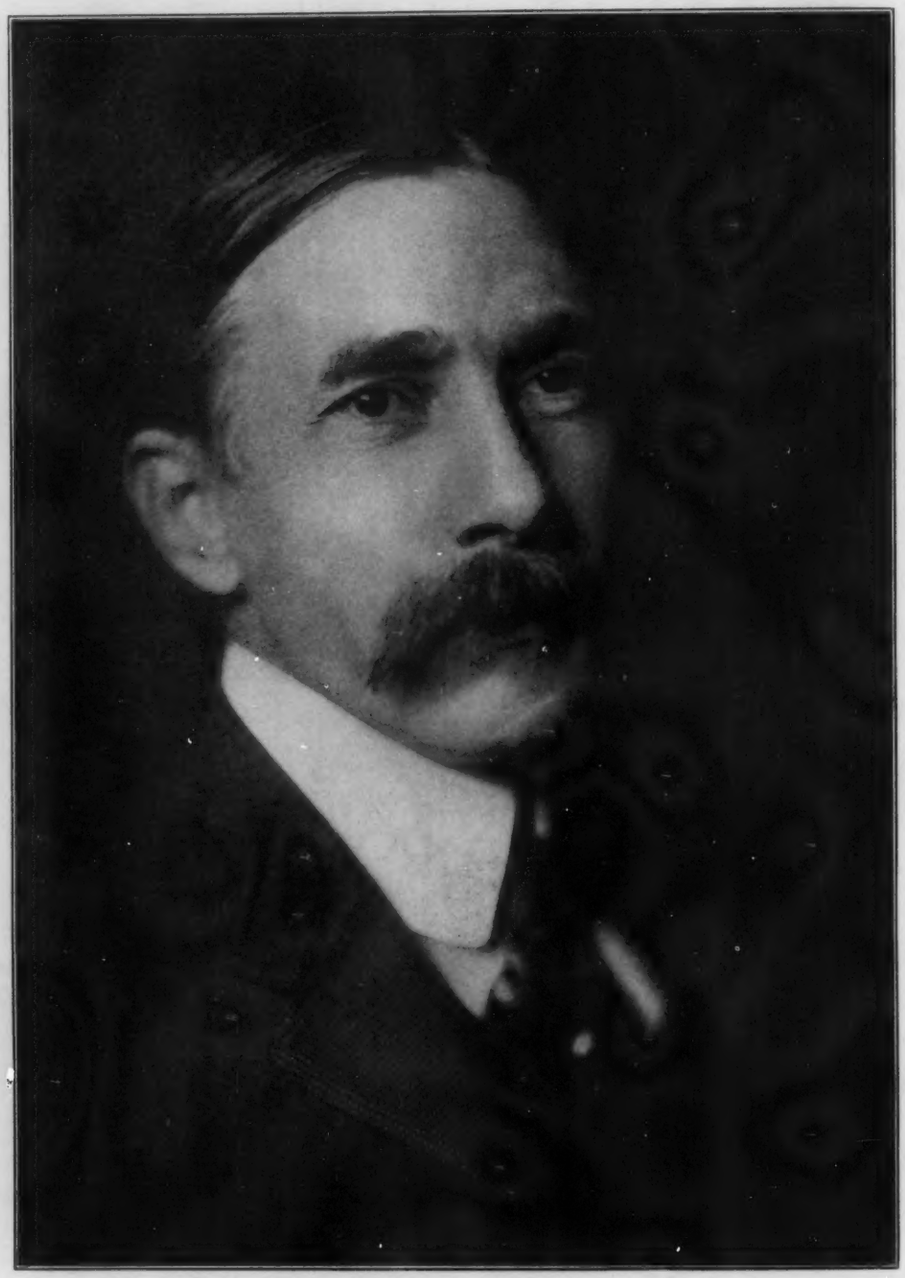


Frederic A. C. Perrine.
First Editorial Writer on The Journal of Electricity, Power and Gas.
Died October 20, 1908, at Freehold, N. J.

Journal of Electricity, Power and Gas

Devoted to the Conversion, Transmission and Distribution of Energy.

VOLUME XXI. SAN FRANCISCO, CAL., OCTOBER 31, 1908 No. 18

Notes Concerning the Selection of Steam Boilers and the Design of Boiler Rooms.

By W. B. Gump.

Before the plans for the boiler room of a power station can be completed, the type of boiler must first be decided upon, and following this the exact dimensions must be obtained from the maker. The efficiency of a steam plant, both thermally and commercially, depends primarily upon its boiler installation. It will therefore become evident from what follows that the proper selection of boilers will have as great an influence upon the plant efficiency as the character of the boiler installation. A well-selected boiler may give fairly good results even when poorly installed, while a poorly-selected type which is entirely unfitted for the duty imposed upon it may have the best setting and still not give good results.

The judicious selection of steam boilers necessarily includes the item of cost. In this connection it should be stated that a great many plants are built in which the boiler efficiency is sadly lacking, due to the fact that the first cost has been the paramount object, and as a consequence the boilers installed are neither efficient under the existing conditions, nor could they be improved with the best construction, since they are not fitted for the duty under which they are working. The first cost, therefore—though important—is not the first consideration. If a boiler were to be selected wholly on account of its first cost the efficiency would be sacrificed, and with it the profits on the investment. If, on the other hand, a selection is made with reference only to thermal efficiency, the cost of the installation is likely to be prohibitive and for this reason may forbid a decision wholly upon that basis.

We have, then, to consider factors which are related both to the commercial efficiency (which is the per cent profit on the investment) and the thermal efficiency (which is the ratio of the total heat utilized in evaporation, to the total heat generated in the boiler furnace). The commercial efficiency may be said to include the thermal efficiency, as the former is the one sought in connection with every steam power project. The latter then becomes subordinate, but is, of course, vital to the value of the former.

In selecting a steam boiler, the nature of the fuel which is to be used must first be thoroughly investigated. Existing data on the coal of a certain section of country is almost invariably reliable, and since nearly every type of boiler has undergone extensive experimentation in regard to various grades of fuel, the results of a particular boiler using a particular grade of fuel can be predetermined with considerable accuracy. The items concerning fuel from the thermal standpoint are: Number of heat units per pound; density of fuel; proportion of ash. Considered from the commercial standpoint, the first item is the cost of coal (or other fuel); the next is facilities for transportation.

Since the present discussion is relative strictly to power plants, the marine and locomotive types will not be considered. In regard to the fire-tube boiler, it can be said that its use is now practically limited to small capacities, and these are in connection with installations where the cost of the boiler wipes out all consideration for efficiency of operation. When it comes to water-tube boilers (which compose fully three-fourths of the installations) there exists such a variety of types that a profound study is necessary in order to select the one best suited to a particular plant. The fact that there are so many types at once suggests that there are fully as many separate sets of conditions to be met; also that the opinions of engineers differ as to the design of boiler best suited to a certain set of conditions. If the purchaser were limited to but a few types, the problem would be easily solved, as far as selection without regard to efficiency is concerned. The fact that there is so great a variation in fuel is more directly accountable for the diversity in boiler design than any other one factor. In the case of oil the range of heat values is quite limited, and hence there is more uniformity in the dimensions of oil-burning boilers than in those burning coal.

A steam boiler is designed to evaporate a given number of pounds of water per hour at a specified steam pressure. Its rating is made accordingly, and is based upon a given area of heating surface per pound of water evaported. A certain proportion of heat is lost through radiation, and a still larger amount is required to furnish draft, and thus escapes through the chimney. When operating under normal conditions, the rate of heat transfer through the tubes is at its maximum, which means that the rate of heat absorbed by the water per unit of time is also at maximum. When a boiler is "forced," it therefore follows that a larger proportion of heat is wasted in order to increase the temperature of the heating surface, and hence increase the evaporation. In addition to this increased waste, there is a deficiency in the combustion which is frequently made evident by dense smoke which appears as soon as the draft is increased. From these facts it becomes evident that a boiler plant should have ample capacity to provide for the heaviest load without forcing.

After an investigation has been made of the coal which is most feasible to use in the locality of the plant, complete specifications should be formulated, and should include the amount of grate surface, heating surface, steam space, and water space. The latter item (the amount of water space) is important, and will have a direct bearing upon the number of boilers in the battery, and on the load factor of the plant. For example: In a factory plant which operates only ten hours out of twenty-four, a large water space means a large amount of heat necessary to get up steam. This heat (most of it) is lost during the fourteen hours that the boilers are idle and must be made up each time the fires are started. With a greater steam space, and a smaller water space, the accumulated heat is less, and hence the loss is minimized. In the case of a plant running on a twenty-four-hour load, the water space might be increased considerably more than in the

former. It is not considered advisable, however, to have more than a sufficient quantity of water for the purpose of safety. Too much water causes priming, and hence is objectionable. The steam space should be so proportioned that the running of engines will not draw too great a quantity of steam from the boiler at one time. Besides interfering seriously with the quality of steam drawn, this would cause pulsations in the steam pressure which are highly objectionable. The heating surface is the next to be considered. There will be approximately three pounds of water evaporated per square foot of heating surface per hour in most boilers. It is important, if bituminous coal is to be burned, that a large combustion chamber is provided, and that it is so designed that the tubes are not too close to the heated gases. Otherwise they are cooled by the tubes, and incomplete combustion is the result.

The item of grate surface is one of vital importance, and must conform to the demands imposed upon it by the particular grade of fuel used. For example, a high-grade coal will permit of a more compact grate than a low-grade. The former may have a heat value of approximately 14,500 British

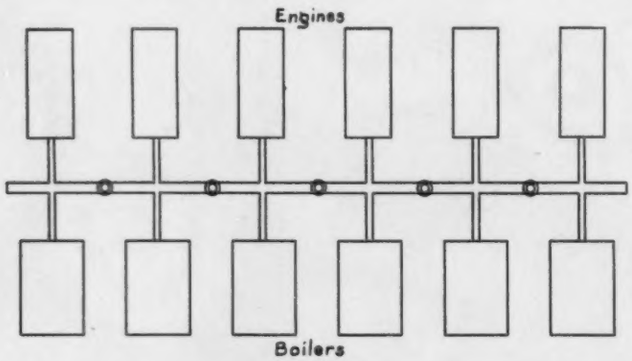


Fig. 1.

thermal units per pound, while the latter may be as low as 10,000 British thermal units; hence the low-grade fuel demands a larger grate for the same heating capacity than the former. Anthracite coals permit a much smaller grate area than the bituminous or semi-bituminous coals, and in the oil-burning type of boiler a still greater reduction is to be attained. Where the question of ground area is a very serious one, it is often advisable to select boilers of the vertical type, as these are of such a design as to permit being installed in a smaller area than the horizontal type.

In selecting a boiler it is of the highest importance to keep in mind the advantage of having access to all its parts for inspection, cleaning, and repairs. A boiler which is constructed so as to preclude access, does not deserve its own space on a scrap-heap, and is a most decided menace to any power plant.

It is most essential that a boiler be designed with an ample factor of safety, and that this is well borne out by inspection of the character of the material and workmanship. When the boilers for a certain plant have been contracted for, if they have not already been made, an experienced inspector should be detailed to visit the boiler works and give evidence to the engineer designing the plant as to the exact nature of the construction of the boilers. Bids should always be based upon specifications which—as far as possible—will insure the most thorough workmanship. If this is done there will be little chance for getting inferior boilers.

Previous to closing the contract for the boilers, the steam consumption of the plant must necessarily have been calculated. The item following this is the number of boiler units, and from this the detailed plans for the boiler room. As a general rule there should be as many boiler units as there are engine units. Far more often the number of boilers exceeds the number of engine units. This will depend, of course, upon the size of the plant, and also upon the load factor. In a small plant of a few hundred horsepower it is frequently advisable to install a boiler for each engine, providing, of course, a complete interchange between boilers and engines. In a case of this kind the method of splitting the boiler capacity into more than the number of units often increases the cost without affecting any additional flexibility, and also increases the operating expenses. There is an increase in first cost in addition to the cost of an extra boiler, on account of having to extend the length of the building. This one fact alone will generally preclude any commercial advantage which might at first seem apparent. When the longitudinal dimension of the boiler room does not correspond with the engine room, unit for unit, it is often found necessary to arrange the boilers in two rows with an aisle running between. This is generally the arrangement found in the larger power station

In designing the piping, the first item to be settled is the initial steam velocity. The best practice demands that this shall not exceed 8,000 feet per minute, and in the smaller plants 6,000 feet per minute, is preferable. The area of cross-section of pipe will then be

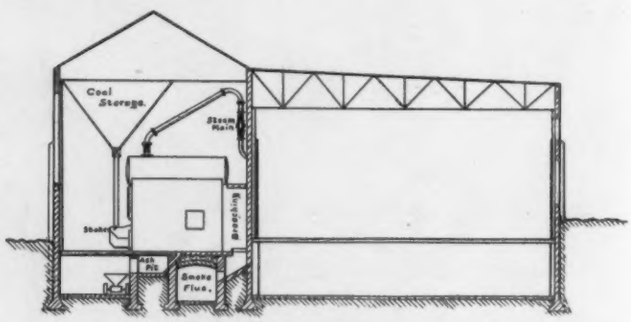


Fig. 2.

$$A = \frac{\text{Area of cylinder X piston speed}}{\text{Mean Vel. of steam}}$$

from which the diameter of the **main steam pipe** (in inches) is

$$D = \sqrt{\frac{144 A V N}{.7854\ S}} = \sqrt{\frac{24 \times A \times V \times N}{.1309 \times S}}$$ (neglecting friction.)

in which A is the area of the high-pressure cylinder in square feet for one unit. V is the velocity of piston in feer per minute. N is the maximum number of engines operating at one time, and S is the velocity of steam in feet per minute.

The simplest arrangement of piping for small and medium-sized plants is shown in Fig. 1. This scheme applies to a plant in which the dimensions of the boilers correspond to those of the engine units, or nearly so. The side elevation taken through the center of the plant is shown more in detail by Fig. 2. The number of valves required in the main steam pipe will obviously be one less than the number of pipes entering the steam main from the boilers. Thus three are required for each steam feeder leading from the boilers. The total number of valves—exclusive of the throttle valves—will be one less than twice the number of boilers.

A system which is somewhat more flexible, is the "ring" system shown in Fig. 3. It will be evident that for a plant similar to that of Fig. 1, more than twice the pipe will be required, and fifty per cent more valves, the number being three times the number of boiler feeders. Two-thirds of these must be the same size as the main steam pipe which is necessarily much larger than the former case, from the fact that none of the boilers can feed in a direct path to the engines; hence the weight of piping is more than doubled for the same output. This arrangement is not to be recommended for small plants, on account of the extra cost. In large stations, however, it is feasible since continuity of service is of paramount

importance and the additional piping is but a small portion of the total cost of the plant. The ring system is improved by the addition of connecting pipes, shown in Fig. 4. By means of cross-connections a more direct path to the engines is afforded, and the size of pipe is reduced. One disadvantage is the fact that it becomes more difficult to allow for expansion than in the previous case. More valves are required than in the other systems, but they are smaller size.

There are some arguments for installing duplicate piping, but the best modern practice tends toward a single system of piping, which is constructed in a manner that will prevent any possible interruptions in service. The disadvantages of a duplicate system are:

First. One-half of the piping is lying idle most of the time.

Second. Said piping is liable not to be in the best condition when called upon for service.

Third. Large pipe is required throughout both systems, as either set must be able to operate the entire plant.

For pressures above 150 pounds gauge, extra heavy pipe should be used. Screwed flange joints with copper gaskets are

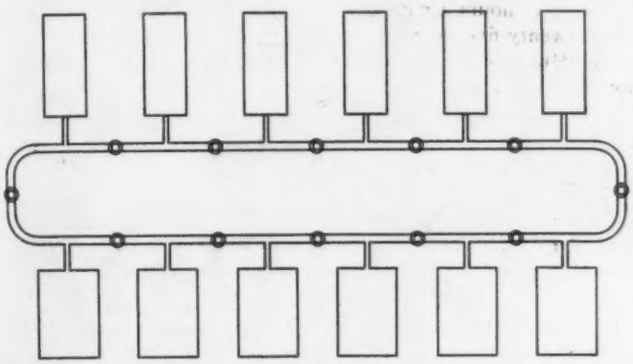


Fig. 3.

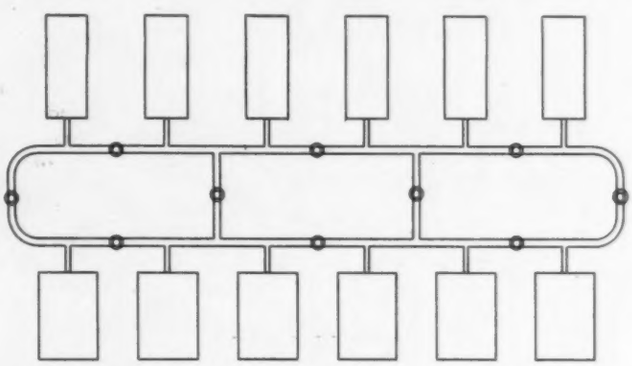


Fig. 4.

satisfactory, except for extremely large steam mains, in which case the shrunk and riveted flanges are recommended. The style of flange is often a matter of personal opinion, depending on the experience a certain engineer has had, and therefore the flanges he has used will continue to be preferred if they have been satisfactory. It is imperative that first-class valves be used, since the failure of one of these may be the cause of a serious interruption in service. This is fully as important in the case of small piping, from the fact that good valves in connection with small piping permits of satisfactory workings of the auxiliaries, while inferor fittings would prevent their proper working and hence cause a marked influence upon the efficiency of the plant as a whole.

The boiler feed line deserves most careful attention, and it is safe to say that in all steam plants of over 1,000 horsepower there should be a duplicate feed line. It is the writer's experience that frequent interruptions of service may be caused by trouble in the boiler feed line. The extra expense of installing a duplicate system is so small compared to the advantages gained by continuity of service, that no argument in favor of a duplicate system is necessary. The method of supporting a feed line is a question worthy of careful consideration. Boiler feed piping is often subject to severe pulsations caused by the pumps, hence the bends and fittings are exposed to strains beyond those of pressure alone. Sharp turns should therefore be avoided, and there should be only such bends as are necessary for the proper fitting of the pipe, with provision for expansion.

The question of boiler feed pumps has been so thoroughly worked out that little can be said further than to state that the best pumps are none too good. Every boiler room should have two pumps. The exception might be in the case of a very small plant where an injector might be used to take the place of one pump. In large stations (those of 10,000 horsepower and over) it is well to have three pumps. As to efficiency, the steam-driven pump is superior to the motor-driven. There are, of course, conditions other than that of efficiency which may warrant the installation of motor-driven pumps. One distinct advantage of the motor-driven pump is that no steam piping is required, hence no steam cylinders to maintain, and furthermore the pump may be situated in a place more convenient to a particular layout than would be permissible with the steam-driven type.

The item of coal storage is one of considerable importance, and in any power station there should be ample capacity to provide for running the plant thirty days. In very large plants storage for sixty to ninety days is to be recommended, as delays in the transportation of coal might otherwise cause a shut-down. The seriousness of such an incident needs but little comment. In the case of large stations a shut-down is something that simply must not take place. For this reason every possible means for its prevention is exploited.

The responsibility which is connected with a power station necessarily increases with the size of the plant. Continuity of service therefore becomes more imperative where there is a large capital involved. These statements should not convey the impression that interruptions of service are to be excused in small installations, but the amount of loss entailed during such interruptions is, of course, not as far-reaching as in the case of larger stations.

A good general arrangement for a storage bin is shown in Fig. 2, which is typical of a plant using mechanical stokers. It is often convenient to construct the storage bin of concrete, though many plants are adopting sheet-steel construction. The choice of these two methods depends mostly upon the local conditions of the case in hand.

Coal-handling apparatus is necessary in all steam plants of over 10,000 horsepower, and in a great many plants of a smaller capacity. Apparatus for removing ashes is to be considered in many plants of 5,000 horsepower and under, and is advisable in all plants larger than that capacity. A method of removing ashes by suction has been used successfully in quite a number of plants. This is accomplished by means of a steel pipe or concrete duct running under the boiler-room floor and into which a pipe is connected from each ash hopper.

The most careful attention must be given to the design of the breeching and smoke flue, as well as the chimney. All of these items are of such importance as to exert a marked influence upon the economy of the plant, and any one of them may, when improperly designed, do much to offset the good features of the others.

Concrete is now being used very extensively in the construction of chimneys and flue-connections, and its advantages hardly need mention. A given battery of boilers requires a specified flue area. Where it is found necessary to carry the gases a great distance, this area must be increased to provide for friction. It should be stated that a long smoke flue is

both costly and objectionable. With a large battery of boilers it is better, when the arrangement can be made, to construct two chimneys, using one for each half of the battery.

The selection of stokers is an item requiring good judgment, and must be decided primarily upon the nature of the fuel which is adopted. Local conditions will determine the best stoker to install.

A few statements are warranted in regard to superheaters, since every modern steam plant must give this subject the most careful consideration. The increased first cost of super-heating equipment is small compared to the advantages gained. This is well demonstrated in a large number of plants now operating successfully and economically with high-pressure super-heated steam. Super-heating provides a means which counteracts priming, and permits of a more constant steam pressure. Dry steam and constant pressure are two essentials connected with steam turbine operation. The first of these (dry steam) is imperative for satisfactory working of the reciprocating engines. The degree of super-heat to adopt should be decided upon the basis of operating conditions. In general, it is well to maintain only a moderate temperature, due to the difficulties encountered in the way of cylinder lubrication, and the danger of break-downs at pipe joints. As to the feasibility of employing super-heated steam, no fixed rules can be given, as the local conditions will have to decide each case.

In conclusion, the question of economizers should be taken up. It may be stated as a safe rule that most steam plants of 1,000 horsepower and over may profit by the installation of economizers, provided the load factor is not too low. With oil-burning boilers, the chimney temperature is more easily controlled, and with a balanced draft system it is argued that economizers may not be necessary. The local conditions of each case will have to be considered in making the final decision on that point.

THE ELECTRICAL CLUB.

The Electrical Club, which is in process of organization in San Francisco, received further impetus on October 24th, when thirty-five members met at the Bismarck Cafe, Fourth and Market Streets, and took definite steps towards placing the organization on a permanent basis. Among other transactions recorded was the adoption of a resolution providing that in future applications for membership must be made through the secretary, R. D. Holabird, 527 Mission Street, San Francisco. The suggestion to place on the stage a musical comedy for the purpose of raising funds was definitely adopted, and a committee was appointed to take charge of the matter. It was decided that the comedy will be presented at one of the local San Francisco theaters at an early date in December. After luncheon those members musically inclined gathered around the piano, kindly furnished by the management of the Bismarck, and devoted considerable time to that class of music known as "close harmony with barber-shop trimmings." A great deal of enthusiasm was shown, and the future of the club appears to be assured.

THE ARMOUR ENGINEER.

During the coming year there will be published Volume I of "The Armour Engineer," the semi-annual technical publication of the student body of Armour Institute of Technology. This is an engineering magazine issuing two big copies each year, one each semester. It contains technical articles by prominent Armour graduates, results of research in the Armour testing laboratories, best papers presented to the Engineering Societies, editorials, book reviews, Engineering Notes and Comments.

THE VALUATION OF A STEAM-POWER PLANT.

The determination of the value of an operating power plant involves the consideration of many factors. It is seldom that they are more critically considered or more clearly presented than in the following extract from a paper by Mr. Chas. T. Main, of Boston, an engineer of wide experience in the valuation of manufacturing and power properties, particularly in connection with the textile industry:

"The value of a steam-power plant will depend upon its character and its condition; and its condition depends very largely upon the service which it has rendered.

"With good water and good care, running about twelve hours a day, the life of a boiler should be about twenty years, or the depreciation five per cent a year. Slow-speed engines, running ten hours a day, can be estimated as having a life of about twenty-five years, or a depreciation of four per cent a year. High-speed engines are much shorter lived, and will not average over fifteen years, or a depreciation of about seven per cent a year; and often times it is greater when run ten hours a day. The depreciation when run twenty to twenty-four hours a day is correspondingly greater. Boiler settings and piping should be included with the boilers, and engine foundations and piping with the engines.

"The life of economizers varies with the initial temperature of the entering water from about ten years up to forty.

"The proper type of engine to use depends upon the use which can be made of the steam after passing the engine; and if the most economical plant commercially is not installed, the purchaser must make such allowances as will make good to him the difference in running expense, over and above what a new plant would cost him to run.

"If steam is to be used for power exclusively, the compound or triple-expansion engines of proper designs are the most economical, and for mill work the compound is the more common of the two.

"If more or less low-pressure steam is required for other purpose than power, this type in a special form can be used to advantage, except in such cases as require nearly or quite the same amount of low-pressure steam as would be exhausted from an engine producing the amount of power required. Such a condition as this might exist where small amounts of power and large amounts of low-pressure steam are required, as in a dye-house or printery, or in case a portion of the power is produced from water, and the other portion from steam, the power of the latter being such as to supply the required amount of exhaust steam for the various purposes to which it is put.

"In such cases as these, it would be absurd to add a condensing cylinder to the engine, and then supply the low-pressure steam direct from the boilers, through reducing valves. The proper type to use here would be the simple or compound non-condensing engine.

"Between these two extremes, of steam used for power only, and an amount of low-pressure steam used equivalent to the whole amount exhausted from the engine, lie nearly all the cases of ordinary practice.

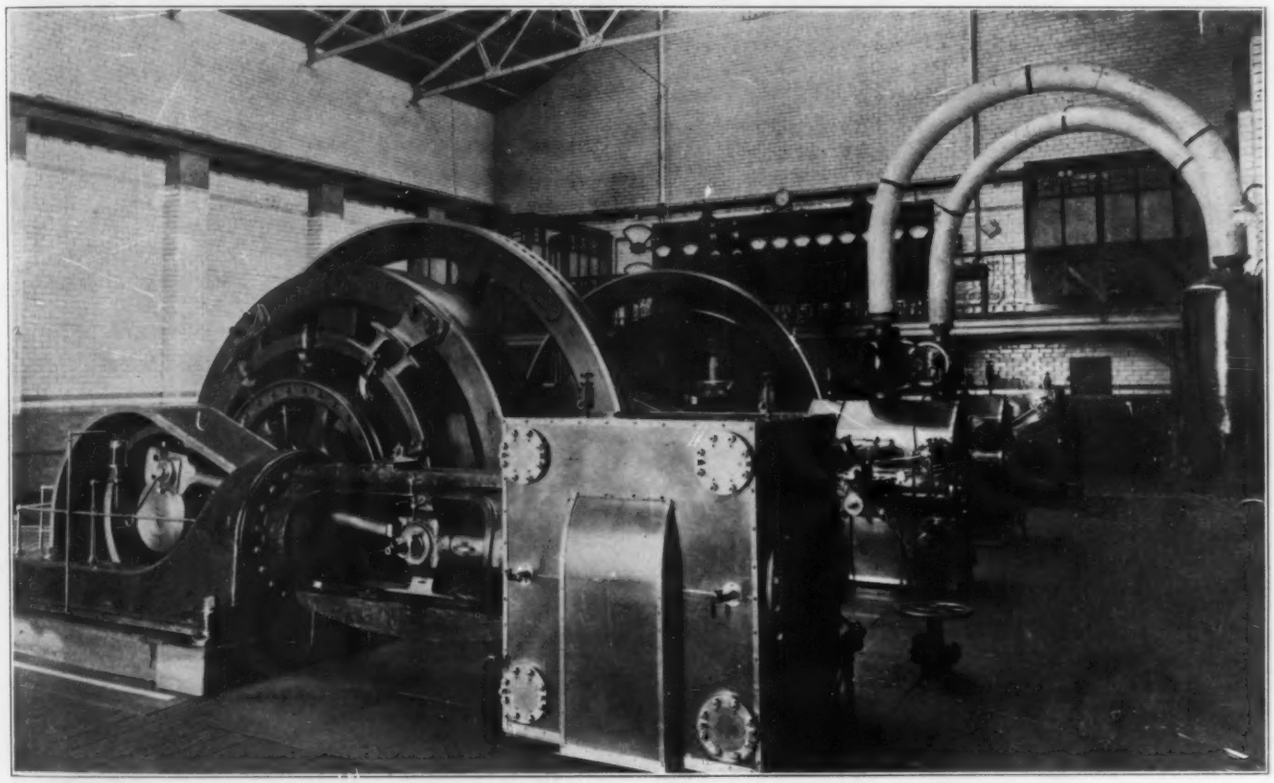
"There is one advantage of the compound condensing over the non-condensing engine with variable amounts of exhaust steam used, viz., the low-pressure cylinder, being arranged for a variable cut-off, can control the variation, thus making use of all the steam, decreasing the amount used in the high-pressure cylinder, and preventing any wasteful and unpleasant blowing-off of exhaust steam.

"The practical limit of the average proportion of exhaust steam which can be used and still employ the compound system, when the quantity required is variable, is when that proportion requires equal cylinders on the compound engines; and this limit is established by the ability to control the steam exhausted from the high-pressure cylinder."

REPORT ON SYSTEM OF GARBAGE DISPOSAL.

As preliminary to the installation of a system of garbage disposal in San Francisco, an advisory committee has presented an account of the refuse destructors at Seattle, Washington; Vancouver, B. C.; and Portland, Oregon. The inspection was made by Messrs. T. B. Berry and L. M. King, and Supervisors Henry Payot and A. H. Giannini, of the Hospital and Health Committee.

The destructor at Portland is of the Engle type, requires fuel for burning, and is used for the destruction of wet garbage and dead animals only. About thirty tons per day are being consumed, and the destruction is not complete. The remainder, including ashes and dry refuse, is dumped on low-lying lands.



English Electric Railway Power House Supplied With Steam from Refuse Destructor Plant.

As this type of destructor is not suited to the conditions here, any further description is unnecessary.

The Seattle destructor is a Meldrum, with four cells, having a capacity of sixty-seven tons per day of twenty-four hours. The forced draft is by a steam jet beneath the grates and a steam jet in the chimney. It is believed that this form of forced draft is not so easily controlled as would be a fan forced draft, but is useful under certain conditions. The noise from the exhaust steam is objectionable, but this can be obviated when more of the power is used.

The plant is equipped with a B. & W. water-tube boiler, which was carrying 140 pounds of steam during our several visits to the place. Two hundred horsepower is generated, which is at present used only for the steam forced draft and for running a small rock crusher used to crush the clinker for concrete. The greater portion of the power is going to waste, but will be utilized later.

The refuse is fed by hand into the furnace in front, and the clinker is removed from the same doors.

The heat generated is intense, and entirely consumes all refuse except a few very refractory kinds which are destroyed in the combustion chamber. The high temperature secured at the plants in Seattle and Vancouver is the secret of the success of these destructors. The temperature in the combustion chamber of the Seattle destructor is from 1,800 degrees to 2,800 degrees Fahrenheit, and the average temperature is 2,300 degrees. All smoke and gases from the grates must pass through this combustion chamber, where they mix and are burned before entering the chimney. As a temperature of 1,800 degrees Fahrenheit is sufficient to destroy all combustible gases, it will be seen that there is little chance for any objectionable odors to escape from the chimney. Analyses of the gas at the base of the chimney show less than one-fourth of one per cent of burnable gas. From the combustion chamber the hot gases pass through the boiler tubes and thence pass through the regenerator tubes, which heat the air used for the forced draft to over 300 degrees Fahrenheit.

There was very little smoke escaping from the chimney, which is only eighty feet high, at the times we visited the plant, although it was in full operation, and most of that observed was apparently steam from the steam draft in the stack.

There were no odors about the plant except immediately over the garbage bin, and this is obviated at the Vancouver plant by the air ducts for the fan draft system. The garbage is entirely consumed, the refuse therefrom consisting of fine ash and clinker.

The temperature in the combustion chamber at this plant is so high that even tin cans are successfully destroyed. The cans are left in the combustion chamber for two or three days where they are either melted or burned brittle, so that they come out in fragments and are suitable for filling.

The plant at Seattle cost $36,000 to construct. It is only a sixty-seven-ton plant, and the building around the furnaces is only temporary.

The operating cost at present is seventy-one cents per ton. They expect to reduce this twenty cents per ton when certain changes are made in dumping the refuse and thereby reducing the labor. When the waste power is utilized and clinker is

sold, the cost can be still further reduced.

No fuel is used, as the garbage, which is mixed refuse similar to that in this city, burns itself.

The destructor at Vancouver is a Heenan & Froude. It consists of only three cells, and has rated capacity of fifty tons per day. It cost, complete, $41,193. It has a permanent brick building, and is also equipped with a steam disinfecting plant for the use of the Health Department in disinfecting clothing, etc.

The operating cost at this plant for a five months' run was fifty-six cents per ton without deducting revenue received, or forty-six cents after deducting revenue. This plant differs from that at Seattle more particularly in the kind of forced draft, the method of firing and the system of ventilation.

The forced draft is by a centrifugal fan which forces air, heated to 500-600 degrees Fahrenheit, through the grates, quickly drying the garbage and causing it to burn rapidly with an intense heat.

The furnaces consist of a single long grate, but with separate front and back doors and separate closed ash pits. They are fed by hand from the back and clinkered from the front, which, your committee believes, to be an advantage over single front hand feed.

The ventilating system is such that all air inside the building and from the garbage bins is drawn into the air ducts and forced by the fan draft through the fire and burned so that no odors can escape from the building.

Your committee considered that in these three respects the Vancouver plant was an improvement over that at Seattle, but that the Seattle plant was superior in its combustion chamber, resulting in more complete combustion of gases. Both plants, however, consume their garbage completely and without any objectionable odors, and may be considered as working successfully. The temperature at the Vancouver plant is from 1,500 to 2,000 degrees Fahrenheit, which they consider sufficiently high.

At this plant large dead animals, such as horses and cows, are destroyed in the combustion chamber in about three hours. This can also be done in the Seattle plant, but at present such animals are sent to reduction works for making fertilizer.

The heat from the combustion chamber is utilized in generating steam in a B. & W. boiler. This steam power is used to run the fan forced draft, and for operating the steam disinfecting plant. A 500-light electric light plant is under consideration.

The Vancouver plant is located in the business district, in a block facing one of the main business thoroughfares, and is only 200 feet distant from the street. It is surrounded on three sides by business houses.

1. The examination of the operation of the plants at Seattle and Vancouver demonstrated to the satisfaction of your committee that it would be entirely feasible to construct in San Francisco destructors that will entirely destroy the garbage and refuse of this city in a sanitary manner and without causing any objectionable odors, so that such destructors can be operated in any part of the city without being a nuisance or giving cause for any legitimate complaints.

2. The power generated by such plants can be utilized to great advantage in San Francisco for pumping water for the high-pressure reservoirs to be constructed on Twin Peaks, for pumping sewage in the new sewer system, and for many other purposes.

3. Before it can be determined just what type of destructor will most satisfactorily destroy San Francisco's refuse, it is necessary that some preliminary work be done to ascertain definitely the quantity and percentage of ash, wet garbage and dry refuse produced in different sections of the city. As the months of July, August and September produce more wet garbage than other times of the year, it is very necessary that this investigation be commenced as near September 1st as possible. The whole subject being of such importance it is further desirable, before coming to any definite conclusion, that a further investigation of existing successful destructors be made.

Your committee therefore makes the following preliminary recommendations:

1. That the City Engineer be authorized and provided with funds to employ inspectors, one or more of whom would be on duty at the Sanitary Reduction Works at all hours when refuse is being delivered there. Such inspectors to note the following:

a—Number of loads hauled each day.
b—Locality from which collected.
c—Weight of each load.
d—Estimated percentage of ashes, wet garbage and dry refuse in each load.

2. That the City Engineer be requested to have analyses made of the garbage and refuse of San Francisco, to ascertain its composition and calorific value.

CIVIL SERVICE EXAMINATION.

The United States Civil Service Commission announces an examination on November 23-24-25, 1908, to secure eligibles from which to make certification to fill a vacancy in the position of electrical engineer and draftsman in the office of the Supervising Architect, Treasury Department, Washington, D. C., at $1,200 per annum, and vacancies requiring similar qualifications as they may occur. The examination will consist of: Mathematics (comprising arithmetic, geometry—plane and solid—algebra to and including problems involving quadratics, plane trigonometry, and mensuration); theoretical and practical questions in electrical science (covering the subject with special reference to lighting and elevator work in public buildings); drawing and design (involving ability to design and draw plans, etc., for all apparatus and machinery connected with electrical work in public buildings); and training and experience.

The United States Civil Service Commission announces an examination, on November 25, 1908, at the places mentioned in the list printed hereon, to secure eligibles from which to make certification to fill three or more vacancies in the position of office engineer in irrigation and drainage investigations, Office of Experiment Stations, Department of Agriculture, at salaries ranging from 1,200 to $2,000 per annum, and vacancies requiring similar qualifications as they may occur in that department. The examination will consist of:

Education, training, and experience (rated on application and on testimonials from references supplied by the applicant); thesis (submitted with application); report writing. In addition to general and technical education and experience, the application should show especially the training, experience, and ability of the competitor in general agriculture and agricultural irrigation and drainage, hydraulics, editing, abstracting and indexing, office routine, and administrative and executive duties, and together with the testimonials should give proof of his tact and business ability. Candidates who do not receive a rating of at least seventy per cent on education, training, and experience, will not be rated upon the remaining subjects. The material submitted under the second subject of the examination may consist of several different articles, preferably on scientific or technical subjects. It should show, as far as possible, the breadth of training and experience of the applicant, and his facility in English composition. It may be submitted either in the handwriting of the competitor or in typewritten or printed form. The duties of this position will be performed chiefly, although not exclusively, at Washington, D. C., and will consist largely of conducting general correspondence, administering office details, editing technical reports and manuscripts, verifying computations and estimates, making abstracts, and supervising field work. Since the duties of the positions to be filled from the register established through this examination are so varied, a lack of training along any single line mentioned will not bar a competitor if he has sufficiently high qualifications along the other lines.

ATTITUDE OF THE LAW TOWARD ELECTRICITY.

By Emerson W. Read, B.L., L.L.B., Member of the San Francisco Bar.

The liability of companies operating trolley wires has been often defined in cases where their highly-charged wires came in contact with wires ordinarily harmless. Both the company operating the trolley wires and the owner of the ordinarily harmless, owe a duty to the public of protection from the dangers incident to the contact of the two kinds of wires. Some jurisdictions have imposed the greater burden upon the company which operates the charged wire, practically holding that that party should exercise greater care and diligence to protect innocent parties than the owners of non-charged wires. The duty of the owner of the non-charged wire is thus stated in the note in the American St. Reports: "It is the duty of a corporation maintaining comparatively harmless electric wires, such as telephone wires, to use reasonable care to prevent them from coming in contact with naked wires carrying powerful electric currents."

The State of New Jersey has followed such rule, as shown in N. Y. etc. Tel. Co. v. Bennett (62 N. J. L. 742).

A common and equal duty may arise between the two owners relative to such wires. In the case of McKay v. Southern Bell Tel. Co. (111 Ala. 337), the facts occasioned the exercise of such a duty. A telephone wire and a trolley wire ran parallel and in dangerous proximity. The telephone wire so swung that it was likely at any moment to fall upon the trolley wire. Its own frail strength and insecure fastenings made it a nuisance and apt to occasion damage and loss of life. The court there determined that it was the common duty of both companies to abate the dangerous condition, where "the danger is within the concurrent, common knowledge of both, and they are jointly liable for injuries caused by a contact of the wires, especially when they allow them to remain in that condition." Further than that the court held that "although an electric street railway company erects and maintains its trolley wire in a manner that other trolley wires are erected and maintained by many prudent and well-managed electric railway companies, conducting the same character of business over and along the streets of other cities, it is negligent where it knowlingly suffers a wire of a telephone company to be suspended over its own, in a condition likely to fall across its own, involving danger to persons and property on the street, without providing proper safeguards."

The court, speaking of this duty as between owners of trolley wires and telephone wires, in City Elec. St. Ry. Co. v. Conery (54 Am. St. Rep. 262), well said: "This duty is not limited to keeping their own wires out of the streets, or other public highways, but extends to the prevention of the escape of the dangerous fluid in their service through any wires brought in contact with their own, and of its transmission thereby to any one using the streets. Only in this way can the public receive that protection due it while exercising its rights in the highways in or over which electric wires are suspended."

The amount of litigation arising out of this duty has been considerable, and the doctrine of law is now completely defined and established. An Alabama case has somewhat lessened the harshness of the general rule. This case, Jones v. Finch (128 Ala. 217), holds that "if persons negligently cause a telephone wire to fall and remain across a trolley wire, becoming charged with electricity from the trolley, their negligence is the proximate cause of an injury to an animal coming in contact with the wire, and it is of no consequence that the negligence of the owner of the trolley, in not providing fenders against the telephone wires, was a conjunctive cause of the accident." In other words, the court could not hold the trolley owner liable, even though negligent, when the proximate cause of the injury was the negligence of those who allowed the telephone wire to fall.

But, in the case of Kanakekee, etc., Co. v. Whittemore (45 Ill. App. 484), where the evidence showed that a telephone wire had fallen upon a trolley wire and had completed a circuit, and that a passing trolley pole had brushed the telephone wire onto a horse, the telephone company was exonerated and the responsibility placed upon the railway company.

Besides intersecting and parallel wires there is another system or practice of stretching wires that makes them extremely dangerous. This is the system known as the "pulley wire" and "guy wire." "Guy wires" very often are so placed as to be within easy reach of persons standing on the ground and at a considerable distance from the power wire. Such wires are very often broken down through reasons of carelessness or otherwise. If properly insulated they are safe and seldom lead to dangerous results. However, the possibilities of accident are very evident, and on several occasions courts of last resort have found it necessary to apply rules of law in matters involving "guy wires."

In the case of Neal v. Wilmington etc. Ry. Co. (53 Atl. 338), the damage resulted from the fall of a wire used to support a trolley wire. In its fall the supporting wire became charged and injured a pedestrian. In that case the company received notice that the wire was down and failed to protect the public against it. It was the latter feature of the case that rendered the company liable. In all trolley wire cases where the trolley-pole breaks the wire, the company labors under a presumption of negligence. Unless this presumption is rebutted by the company the injured party may recover. This applies, even though the wire may have been perfect in every particular and fell only because of the stroke of the trolley-pole. This is merely an extreme application of the rule that companies must exercise a high degree of care and maintain lines in a good and safe condition (Chattanooga Elec. Ry. Co. v. Mingle, 103 Tenn. 667). In that case the defense set up the rule that "those who go on a highway may well be held to do so subject to their taking upon themselves the risk of injury from inevitable danger, where carelessness cannot be charged upon anyone."

It is interesting to see what view the court took of this defense, and of trolley-pole strokes on trolley-wires. Commenting on this, the court (Beard, J.) said: "But was the fall of a dangerously charged guy wire an inevitable danger? That it was unexpected is no doubt true; but many accidents occur from defective mechanical contrivances which, though not anticipated, are by no means inevitable, because they might have been avoided by the exercise of care corresponding with the danger attendant upon the contrivance. In the case at bar the guy wire, charged as it was with a heavy electric current, was suspended over a street crowded with persons, passing at all times of the day, was intrinsically dangerous, yet the risk of accident therefrom was not inevitable. If the wire was made of good material and was properly attached above and below, and then carefully supervised, there was no inevitable danger incident to its suspension above the street. If, however, the wire were imperfectly constructed or attached, or, if properly attached in the beginning, it was neglected for a period of time sufficiently long for expansion or strain upon it to weaken the attachments, then it did become a menace to the public, and the company, being guilty of the negligence which contributed to this condition, was responsible for the damage proximately resulting therefrom. . . .

It is common experience that in propelling a car, the trolley will sometimes slip from the wire along which it is passing, and if in so doing it comes in contact with a guy-wire, it is apparent that the latter should be of sufficient strength and fixity to withstand the violence of the stroke, and if it fails to do so, it is not an unreasonable inference that there has been negligence in its construction, selection, or supervision."

Because a lot (whereon a post is placed to which is fastened a guy-wire) is vacant, will not relieve the company from its burden of care. In New Omaha etc. Light Co. v. Johnson, a Nebraska case reported in 93 N. W. 778, the court held that an electric company must exercise all reasonable precaution against passing a dangerous current through a guy-wire attached to a pole on a vacant, uninclosed lot in a portion of a city that was densely populated.

So stringent is the law relative to currents escaping into guy-wires, that in South Omaha Waterworks Co. v. Vocasek (62 Neb. 710), the court would not regard the defense of contributory negligence when a boy of seventeen years, knowing of the presence of the current in the guy-wires, deliberately placed his hands on it, the owners having had three days' notice of its condition.

As evident are the possibilities of danger in a pulley-wire attached to a suspended arc lamp. In a Kentucky case the pulley-wire was proven to have been uninsulated and allowed to come in contact with feed-wires. While charged by such a contact a boy on the sidewalk grasped the reel on which the pulley-wire was wound, the reel being four or five feet from the ground. In rendering judgment for the plaintiff, the court said: "We think it a self-evident proposition that it was the duty of the appellant, in using the streets of the city of Lexington, by permission of the municipal authorities, for purposes of private gain, to so conduct its business as not to injure persons passing along such streets, and to keep the highways occupied by their apparatus in substantially the same condition as to convenience and safety as they were in before such occupancy." (Lexington Ry. Co. v. Fain, 24 Ky. Law Rep. 1443.)

PROGRESS IN WOOD PRESERVATION.

During the past few years greater advances have been made in methods of wood preservation than many people realize. Lumber users have become convinced that in the chemical treatment of timber and the consequent lengthening of the wood's life, that they can save both the great cost of materials and the labor in renewals.

Just a few years ago a prominent man, in a paper read before the Pacific Coast Railway Club, called attention to the pressing need of a thorough investigation of all processes used in the preservation of wood. At that time he deplored the fact that neither the Government nor corporations would offer inducements to men competent to carry out such investigations. The particular problem which he had in mind was the treatment of piling to make it resistant to attacks of marine wood borers, such as teredo and limnoria. This problem is indeed a serious one, but probably no more so than that of preserving ties, poles, and mine timbers, against decay.

About the same time that this paper was presented before the Pacific Coast Railway Club, the United States Forest Service established an office, the duties of which would be to investigate known preservatives and processes, and to devise means, if possible, whereby the present methods could be improved or cheapened, or new methods developed to take the place of those already in use. Since its inception, the office of wood preservation has made rapid strides. Up to the present time, experiments have been carried on in co-operation with corporations, educational institutions, and individuals, to try out various theories in actual practice, and the results have proved of value, not only to the co-operators, but to a large number of people having interests similar to those to which the particular experiment applied.

Preservative treatment is recognized as a paying proposition wherever construction timber is exposed to soil or atmospheric influences causing decay. This statement is fully attested by the rapid increase in the use of treated timber in recent years. The increase has been most notable in the case of railway cross-ties. All of the larger companies in the West now use treated ties to a greater or less extent, and many of them operate their own treating plants.

It is also notable that the use of treated timber is confined principally to corporations requiring very large quantities of construction material. This is largely accounted for by the fact that the pressure system of impregnation in common use requires expensive retorts and machinery, and is not adapted to a plant of small capacity, thus making it impracticable for a concern using a small or moderate amount of timber to undertake treating.

Besides the plants operated by corporations for the treatment of their own construction timber, there are a number of plants which do a commercial business, but these being located at centers of distribution, where a permanent business is more readily assured, are not accessible to timber which goes direct from forest to consumer without passing through such central distribution point. For economy, the treating should be conducted at a point where additional transportation charges on account of the treating will be reduced to a minimum. The ranchman drawing his timber from the adjoining forest, should have on the ranch the means for treating his fence posts and similar materials. The mining concern should have at the mine a plant with capacity adapted to their needs. An electric company whose lines extend over a considerable area and which draws its timber from various sources, may find a small portable plant best for treating poles.

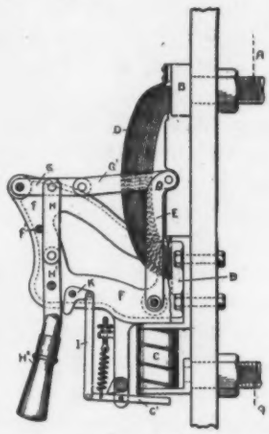
For several years the Forest Service has been experimenting with a method of impregnating wood, which requires no expensive equipment, is simple in operation, and is adapted to a plant of any desired capacity. It is now known that all of the more porous woods can be treated successfully by this method. The method is called the "open-tank" or "hot-and-cold-bath" process. The impregnation is accomplished by thoroughly heating the timber in a tank containing a liquid substance, then running off the hot liquid and filling the tank with cold, or transferring the timber from a tank containing hot to a tank containing cold liquid, or allowing the whole to cool without change.

The theory of the process is that the air in the wood cells and intercellular spaces expands when heated and is partially expelled Upon cooling, it again contracts, thus causing a partial vacuum, and the pressure of the air on the outside forces the liquid into the wood. The process may be applied with any of the preservatives in common use; as, for instance, creosote oil and zinc chloride solution. The principle is the same whether the treating is done in a small tank holding a few fence posts and heated with a wood fire underneath, or in larger tanks fitted with steam coils for heating, pumps for handling the oil, and labor-saving devices for handling the timber.

The results of the Government's extensive experiments in wood preservation are published in circulars and bulletins, which, along with any specific information desired, may be had by all interested persons who address the Forester at Washington, D. C.

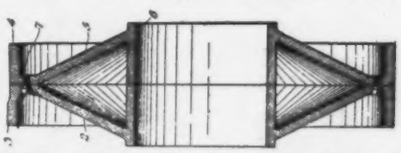
PATENTS

CIRCUIT-BREAKER. 900,693. Charles C. Badeau, Schenectady, N. Y., assignor to General Electric Company, a corporation of New York.



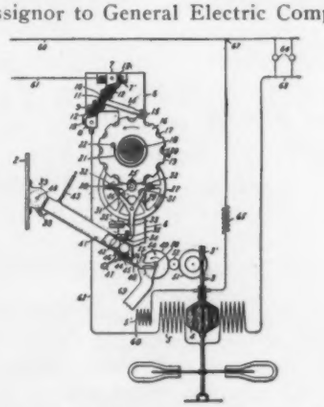
In an electric switch, the combination with fixed and movable contacts, of inter-operating toggles connected in tandem to multiply the force exerted on the movable contact, one of said toggles being overset in the closed position of the switch to lock the contacts in engagement.

TURBINE-ROTOR. 900,700. William A. Bole, Pittsburg, Pa., assignor to The Westinghouse Machine Company.



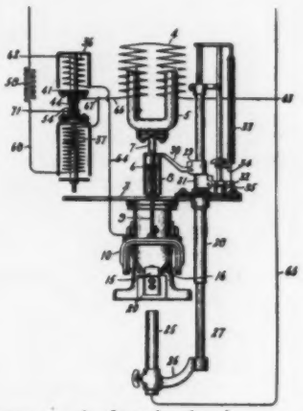
In an elastic fluid turbine, a drum consiting of two Z-shaped sections combined to resist lateral distortion when subjected to the actions of centrifugal force and lateral fluid pressure.

PREPAYMENT-METER. 900,777. William H. Pratt, Lynn, Mass., assignor to General Electric Company.



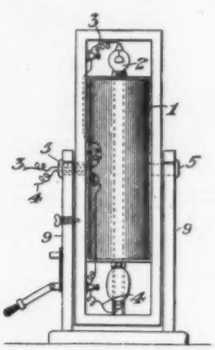
In a prepayment device, a meter, a switch, operating means therefor, including a movable coin chute arranged to be held in one position when empty, and in another position when one or more coins are contained therein, a catch normally preventing the escape of coins from said chute, and adapted by its movement to release one coin at a time, a weight pivoted at a point remote from its center of gravity, and means driven by the meter for moving the weight over its center of gravity, said weight being arranged to strike said catch in its descent.

ARC-LAMP. 900,718. Richard Fleming and Cromwell A. B. Halvorson, Jr., Lynn, Mass., assignors to General Electric Company.



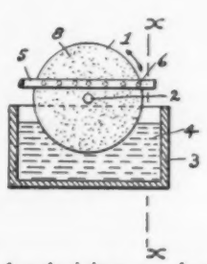
In an arc-lamp, a draft tube having an opening formed in it, an electrode comprising a metallic bar movable through said opening, a shield or guard carried by said bar and arranged to engage the side of said draft tube to limit the movement of the bar in one direction relative to said tube and to assist in closing said opening, and means for adjustably securing said shield to said bar.

ADJUSTABLE SUPPORT FOR VAPOR-LAMPS. 900,719. Stanwood E. Flichtner, Englewood, N. J., assignor to Cooper-Hewitt Electric Company, New York, N. Y.

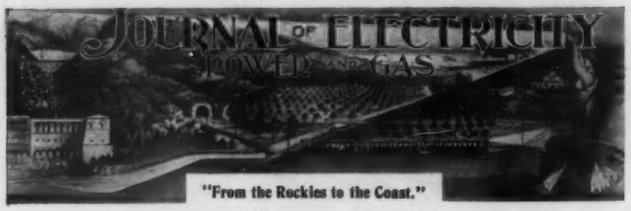


The combination with a tilting frame and a vapor electric lamp supported thereby, of a guide located behind the lamp and extending along practically the entire luminous body thereof, the said guide being of curved form and being adapted to receive reflecting material.

ELECTRIC BATTERY. 901,012. Isidor Kitsee, Philadelphia, Pa.



The method of depolarizing an electrode provided with platinum black, which consists in impinging a jet of air thereon when out of contact with the electrolyte, whereby continued catalytic action of said platinum black is permitted.



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Destruction of Refuse.

In this issue is a brief report of the investigation of refuse destructors in several Pacific Coast cities, which is preliminary to the installation of some such system in San Francisco. Of the several destructors described, the Seattle plant in particular is based on a study of similar efforts in other American and foreign cities. It is seldom that such a thorough and practical study of this problem is made, and the example of Seattle is worthy of all emulation.

From experience gained in the congested districts of England and the Continent, several methods of disposing of waste products have been evolved. Since the terrible experience of the great plague in 1666, England has recognized the importance of speedily disposing of all garbage. In the words of Huxley, they "have learned that pestilences will only take up their abode among those who prepare unswept and ungarnished rooms for them." It is only by keeping everlastingly at it that health can be insured in any community. Most of the English devices for the destruction of refuse are merely incinerators, in which the refuse is burned and the gases allowed to pass into the air, the residue being valuable for nothing but filling. This is both expensive and wasteful, as there are many valuable by-products to be obtained. Properly prepared, it makes an excellent fertilizer, and one ingenious Englishman has proposed that it be pulverized and mixed with tar so that it can be briquetted and used as fuel.

The first obvious saving to be made is in the utilization of the heat. Tests of the refuse from the city of Milwaukee have shown that a pound of steam can be generated from a pound of refuse, most of the material being self-consuming. This steam may be used to operate the plant, pump water, grind clinkers, heat neighboring buildings, or supply power. All these possibilities have been utilized at various plants with varying success. It is doubtful if electrical power generated in small units in this manner can compete with power from large central stations.

The rational solution of this problem, however, would appear to be much the same as that of the utilization of the waste from woodworking. Government and private experiments have shown that sawdust contains many volatile products of commercial value. A Pacific Coast engineer working on these lines has recently perfected a system whereby garbage is subjected to distillation at a temperature of 600 degrees and less. By condensation of the vapors passing off, he obtains pyroliginous acid and tar, yielding acetic acid and some of the phenols. Considerable ammonium sulphate, which is used as a fertilizer, is also recovered. The residue is an excellent charcoal, which with the uncondensed gases furnishes fuel for the process. The inventor claims that there are no disagreeable odors in connection with the operation. If the experiments prove satisfactory on a large scale, they will mark a great advance in scientific sanitation.

Any community about to install a system of refuse destruction should carefully investigate the working of the plants that have been installed in other places before making a decision. Much depends upon the nature of the community and its environment. No plan yet devised is a universal panacea, special conditions requiring special equipment.

SONS OF JOVE AT BUFFALO.

The sixth annual meeting of the Sons of Jove at Buffalo, on October 15th and 16th, was a great success from every point of view. The badger fight was a scream. Over seventy per cent of the crowd had never seen one, and actually thought that surely a badger was in the barrel and would eat up the bulldog.

The Rejuvenation itself, from a spectacular standpoint, was the finest that has ever been held in this country, and demonstrates, as no words possibly could, the possibilities of the Ritual.

In recognition of the interest which Mr. T. E. Bibbins, Jovian Statesman, has shown in the Order during the last year, it was felt that he should be elected as a member of the Seventh Congress, all of the members feeling that the Coast, on account of the character and number of its members, should receive recognition of this kind.

J. Robert Crouse was elected as the Seventh Jupiter. The new Statesman for California will be E. M. Scribner.

The annual meeting limited life membership to fifty, and at this meeting thirteen or fourteen became life members, putting in their $25.00.

The affairs of the Order are in good shape from every point of view. The Congress is a very strong one, and the most representative that has yet been elected. The membership is now something over eighteen hundred.

The following officers were elected for next year's Congress:

Jupiter, J. Robert Crouse, Cleveland; Neptune, James R. Strong, New York City; Pluto, John W. Brooks, Syracuse; Vulcan, Homer E. Niesz, Chicago; Hercules, J. R. Dostal, Denver; Mercury, C. B. Roulet, Dallas, Tex.; Mars, W. A. Layman, St. Louis; Apollo, E. D. McCarthy, Buffalo; and Avrenim, T. E. Bibbins, San Francisco.

The next meeting place of the Jovians is left to the discretion of the Reigning Jupiter, who will announce his selection at a later date.

The concluding feature of the Buffalo meeting was a banquet at the Iroquois, on the night of October 16th. W. E. Robertson, the retiring Jupiter, was toastmaster, and other speakers were Charles R. Huntley, H. B. Kirkland, J. Robert Crouse, Oscar C. Turner, Herbert I. Sackett, and Alex Henderson. There were no set speeches, and the talks were along the lines of fraternity and co-operation.

OBITUARY.

Henry A. Butters, one of California's leading citizens, died at Berkeley, California, under date of October 26th, at the age of 58. Death resulted from an acute attack of congestion of the lungs, his illness covering a period of but two days. Mr. Butters was to a considerable extent affiliated with electrical interests, having established the first electrical tramways in South Africa, in connection with Cecil Rhodes, John Hayes Hammond, and Weiner, Beit & Co. He was later associated with financial and electrical people with whom he established tramways in Mexico City; Geneva, Switzerland; Lisbon, Portugal; and Valparaiso, Chili. He was more recently associated with Louis Sloss, Eugene J. De Sabla, Jr., W. P. Hammond, and other San Francisco financiers in the construction of the Northern Electric Railroad, of which he was president, and it is largely as a result of his courage and strength that this enterprise was brought to a successful conclusion.

PERSONALS.

W. L. Goodwin has returned from a brief vacation of one week and reports himself much refreshed by this brief rest.

R. D. Holabird, of the Holabird-Reynolds Electric Co., San Francisco and Los Angeles, has spent the past week in the neighborhood of Los Angeles and expects to start for the East on November 1st on a business trip of about thirty days.

F. H. Poss, local Pacific Coast manager for the Holophane and Benjamin Electric Mfg. Companies, is making definite plans for a trip to Honolulu, H. I., within the next five or six weeks in the interest of the companies he represents.

Geo. A. Scoville, of the Dean Electric Company, of San Francisco and Elyria, Ohio, has returned from an extended trip through the Northwest. A close observance of conditions in that section convinces him that there is a permanent improvement in business conditions.

Carl Heise, associated with the Westinghouse Electric and Manufacturing Company in San Francisco, delivered a most interesting lecture on the subject of "Single-phase, Alternating-current Railway Systems," in the Mining Building of the University of California, Berkeley, Cal., on the evening of October 20th. The lecture was well attended, both by members of the university and the public.

W. S. Webster, representing the Oriental & Occidental Trading Company, of Shanghai, China, who has spent the last three months in the United States, will return to Shanghai during the next week or ten days. During his visit to this country he has entered into arrangements with numerous manufacturers of electrical supplies whom he will represent in the Orient. He reports prospects for business in that section excellent, and anticipates a considerable extension of trade in the lines he represents.

COPPER MARKET SITUATION.

Locally, the copper market has remained remarkably quiet for several weeks, but notwithstanding the recent low volume of business for domestic account prices here for electrolytic wire bars keep close to 13½ @ 13⅝. These values, however, are not sufficiently attractive to stimulate extensive purchasing by the home trade under present conditions. Reports current regarding recent concessions granted to European buyers in order to promote additional sales abroad naturally suggests the question as to why the domestic consumer should be charged a premium for the copper he requires in the regular course of manufacture. If there are special inducements offered to buyers we cannot understand why this country does not get a chance to share in them. There ought to be as good commercial reasons for cultivating and encouraging buying in this market as in the foreign marts and on a basis equally as fair to our own manufacturers as that upon which the movement to Europe is conducted.

Manufacturing business has improved over the level of six months ago, but it is still much below normal proportions. When compared with conditions prevailing in the most active seasons it is very evident that great progress will have to be made before we reach the heavy consuming basis of 1906 and the early months of 1907. The thing urgently needed just now is more confidence, and when this essential factor regains a strong hold on the financial world business will soon broaden out to the general satisfaction of the entire trade interests of the country. The building up of healthy conditions in business circles is a matter of gradual development, but the slow method should prove more lasting, if thoroughly done, than a more hasty recovery brought about by artificial means.

Consumption increases slowly, but not nearly fast enough to take care of the large output. Recent returns show that the production of copper in the United States, Mexico and Canada as compiled for September was more than 10,000,000 pounds greater than in July, and more than 23,000,000 pounds larger than in March.

FREDERIC A. C. PERRINE, A. M., D. Sc.

On October 20, 1908, Frederic Auten Combs Perrine died at his home in Plainfield, New Jersey, a victim of a complication of arterial and kidney troubles; thus bringing to an end a life of usefulness hardly more than well begun. Dr. Perrine was born at Manalapan, New Jersey, on August 25, 1862, and, therefore, at the time of his death, was a little more than forty-six years of age. He was the son of James A. Perrine and Rebecca A. Combs, whose deaths, at a very advanced age, only preceded that of their son's by a couple of years; and indeed it may be said that Dr. Perrine never fully recovered from this loss.

He was educated at the Freehold, New Jersey, Institute, entering Princeton University in 1879, and receiving from that institution the Degree of A.B. in 1883, but remaining as a post-graduate until 1885, when the Degree of Doctor of Science was conferred upon him. In 1886 his Alma Mater conferred upon him the Degree of A.M.

Dr. Perrine was, in every sense, a broadly educated man, differing from many of our more recently graduated engineers who, due to the prevailing tendency to specialization, lack the broadening education that the older curriculum provided, at a period when time was not the important factor in educational matters that it is now. Dr. Perrine, having received a good education in the humanities, was therefore well prepared to take up, as he did, the sciences, and while in college was particularly fortunate in being a close friend, as well as a student, of Professor Brackett. In attaining his doctorate, he was (with A. P. Carman, now professor of the University of Illinois), bracketed as "honor man" at his university, and it was later, through Professor Carman, that Dr. Perrine took up teaching at Stanford University. The habit of study, acquired at college, lasted until shortly before his death; his lines of study broadening all the time, to a degree that it is very difficult for even one who knew him intimately to definitely define the limitations of his knowledge.

Early in his life he specialized in what is now known as electrical engineering, although at that time it was studied more from the view point of a branch of physics. On leaving college, however, he associated himself with the United States Electric Lighting Co. of New York, one of the first electric manufacturing and operating companies in this country, and a company which made much of the early history of electric lighting. Associated with this company was Edward Weston. Dr. Perrine, however, as assistant electrician, was intimately associated with John J. Kelly, who was later one of the founders of the Stanley Electric Manufacturing Co. Dr. Perrine early developed an interest in matters other than engineering, and for many years he devoted considerable time to university settlement and other sociological work, his active interest only relaxing when his professional duties became more exacting.

In 1889 he became associated with John A. Roebling's Sons Co., as manager of the Insulated Wire Department of that company, practically from the inception of that department, retaining this position until 1892, during which time he undertook a great deal in the way of investigation and research, with a view to putting the manufacture of insulated wire in this country upon a scientific basis, publishing during his incumbency the now well-known "Roebling Handbook," a book which has since gone through many revisions and editions, but which, at the time of its first publication, was practically the only comprehensive handbook of the character in this country, the first and some subsequent editions containing one of the best graphical wiring diagrams that had been developed. His investigations, while in the wire business, developed an interest in the subject of conductor materials which lasted until his death, and resulted in the publication of his book on "Conductors for Electrical Distribution" in 1903, which is now in the second edition.* A portion of the contents of this book was published in the form of a serial in the monthly magazine, "Electrical Engineering," of Chicago, now discontinued, and as independent articles in technical publications, later being gathered together and re-written in co-ordinate form for inclusion in a complete volume.

In 1892 he severed his connection with the Roebling Co., and became associated with the Germania Electric Co., of Boston, as treasurer and manager. His connection with this company was brief, owing to its winding up on account of certain incandescent lamp litigation. This was probably fortunate for Dr. Perrine, as it left him free to enter into his happiest and most successful work—that of teaching.

In 1893 he was appointed Professor of Electrical Engineering at Stanford University, in California. Prior to taking up his work in California, he served as a judge, and also as a member, of several important committees of the World's Fair, at Chicago, and on the completion of this work went to California to take up his university work.

At the time of Dr. Perrine's appointment at Stanford University, the electrical engineering department had not been organized, and Dr. Perrine was, therefore, particularly fortunate in becoming associated with a university that was without the handicap of precedent, and the department could, therefore, be developed along original lines, and this he proceeded to do with a success that was generally conceded. At the time Dr. Perrine began to organize his department, there was no well-accepted plan for an electrical engineering course, some institutions including in the course of study a large amount of shop work and other practical work, while others approached it largely from the standpoint of pure theory. Dr. Perrine, having devoted a great deal of his time to the physical and mathematical side, appreciated the value of that method of handling the subject; at the same time, he also understood the value of the shop work, with the result that the course of study he laid out, and to a great degree, put into effect, involved the study of the physical and mathematical side of electricity, with its application to engineering always in mind, and to this end felt that this important groundwork should be taught to engineering students by engineers, so that students would fully appreciate its relation to their subsequent work as they progressed. Shop work, he felt, was valuable, only in so far as the student might become familiar with rather than proficient in the use of tools. Laboratory work, as laid out by him, contemplated the preparation and arrangement of the apparatus and equipment for the experiment along original lines where possible, in many cases involving the construction of all or most of the apparatus necessary, believing that while this limited somewhat the variety and number of experiments, it called for originality and initiative on the part of the experimenter.

Dr. Perrine's success as a teacher was principally due to his personality and intimate contact with his men, and his students gained as much, if not more, from the intimate informal talks as they did from the more formal lectures, and indeed the latter often developed into informal talks that extended long after the stipulated hour of closing—sometimes even being adjourned to his home for an evening discussion.

During the latter part of his incumbency of the Chair of Electrical Engineering at Stanford University, he held the position of Chief Engineer of the Standard Electric Company of California (now a part of the system of the Pacific Gas and Electric Company), being associated in this work with Mr. W. R. Eckart, of San Francisco. Dr. Perrine's work in this connection included the electrical design of the system, which was the first long distance 60-kilovolt transmission plant to be undertaken. For his work in this connection he was awarded a gold medal at the Paris Exposition of 1900.

In 1900 he resigned his chair at the university and his connection with the Standard Company, to become president and general manager of the Stanley Electric Manufacturing Company, of Pittsfield, Mass., a position which he occupied until 1904, when he resigned to take up private practice as a consulting engineer in New York City, which he maintained up to the time of his death.

*"Conductors for Electrical Distribution," F. A. C. Perrine, A. M., D. Sc., 2d Edition, Van Nostrand, N. Y., 1907.

He was very much interested in technical literature, and with Geo. P. Low was editor of the "Journal of Electricity," from its inception in 1894 until 1896, during which time his communications, under the caption of "Passing Comment," created a wide interest, consisting, as they did, of a critical commentary of the technical affairs and developments of the times. From 1893 to 1898 he was an editor of "Electrical Engineering," published in Chicago.

He also prepared a large number of papers, which were presented from time to time before technical societies, educational institutions, and other public bodies.

He was a member of the American Institute of Electrical Engineers, serving on many important committees; of the Institution of Electrical Engineers (London); the American Society of Mechanical Engineers; the American Society of Civil Engineers; the National Electric Light Association, and other technical and learned societies.

His untimely death has taken from our ranks an engineer whose work can hardly be considered to have begun, a type of man whose loss will be felt by all who have ever been associated with him, who gave more than he received, and whose thoughtfulness and consideration was apparent to all. Perrine was a man with decided opinions, which he dared to expound regardless of how they might affect him in his own affairs; as a consequence, there were many who disagreed with him, but none who failed to appreciate his honesty of purpose and his steadfast determination and endeavor to do justice and live aright.

On June 28, 1893, he was married to Margaret, daughter of Ferdinand W. Roebling, who survives him with three children, two daughters, Margaret and Ann, and a son, John.

CHIEF HEWITT REMOVED FROM OFFICE.

William R. Hewitt, Chief of the Department of Electricity of the city of San Francisco, was suspended from office under date of October 24th, at a special meeting of the joint Fire and Police Commissions, by the unanimous vote of the members present, and later in the day President William McCarthy, of the Fire Commission, filed charges of incompetence and insubordination against Hewitt with the Civil Service Commission, looking to his permanent dismissal. Hewitt has ten days under the charter in which to answer the charges, and he may then demand trial.

In his charges President McCarthy alleges general mismanagement in that Hewitt let the work fall behind, employed unnecessary men, poorly distributed them, failed to use the conduits of the telephone companies for the city as privileged by the franchises granted them, and kept no proper records. Hewitt was accused, also, of usurping the authority of the Board in appointing John Felt an inspector without its knowledge, and of presenting false data in reports, as an estimate of $165 each as the cost of 164 proposed fire boxes, when later he testified they could be built for about $67.55. Hewitt, President McCarthy stated, disobeyed explicit orders in not installing conduit connections when the department moved to the Fulton Street headquarters, necessitating expensive alterations.

William J. Nixon, operator in the Department of Electricity, was appointed acting Chief, pending the trial by the Civil Service Commission.

A successor to Mr. Hewitt must come from the Civil Service list, and there is but one eligible besides Hewitt—Caius T. Ryland, who is in business as an electrical engineer, and has on his hands the management of a considerable estate. It is doubtful whether he would accept the $200-a-month position.

APPROVED DEVICES

Electrical Fittings Approved by the Underwriters' National Electrical Association

CABINETS.

"Columbia" pressed steel cabinets for porcelain base service entrance switches or combination cut-outs. For use with rigid metal conduit. Approved Oct. 5, 1908. Manufactured by

Columbia Metal Box Co., 77-79 East 130th St., New York.

CONDUIT BOXES.

"Krantz Elevator Box." Cat. No. 448. A cast-iron, porcelain-lined conduit box, for use as elevator cable outlet. Approved Aug. 20, 1908. Manufactured by

H. Krantz Mfg. Co., 160-166 Seventh St., Brooklyn, N. Y.

Pressed steel boxes, Cat. Nos. 2-6, inclusive, 102, 104, 111, 112, 114. F2-F10, inclusive, 102 A., 104 A., 111 A., 112 A., 114 A. PB2-PB10, inclusive, 600, 600 A. 8N, 8B, 8B deep, 703, 704, 711, 712, 715. 11B, 11B deep, 703 A., 704 A., 711 A., 712 A., 715 A. 15, 1200, 1200 A. 16, 1700, 1701, 17, 17 A., 17S, 1800, 1801.18, 18 A., 18 L., 1900. 85-89, inclusive, 100, 5506, 5561, 1508. Covers of steel, brass, and porcelain, suited to the above boxes. Adjustable cover extension for use with covers 22, 31 and 35. Approved Oct. 3, 1908. Manufactured by

Bossert Electric Construction Co., Utica, N. Y.

CONDUIT OUTLET BUSHINGS.

"Bendluck" couplings. A right-angle coupling for rigid conduits. For use only when cap is left exposed. Approved Aug. 20, 1908. Manufactured by

Fairmount Elec. Mfg. Co., 2320 Market St., Philadelphia, Pa.

"Burns" Terminal Fittings. A two-part, cast-iron device for use at service entrance. Two or three wire. Cat. Nos. 911 to 986, inclusive. Approved Aug. 20, 1908. Manufactured by

J. F. Burns, 47 N. Hutchinson St., Philadelphia, Pa.

CUT-OUT BASES, PLUG FUSE.

"O. K." Fuse Block Cover. A porcelain cover for Edison plug fuse branch cut-out bases, with steel face plate and seals for preventing use of or tampering with branch circuits by unauthorized persons. Approved Aug. 20, 1908. Manufactured by

Pettingell-Andrews Co., 160 Pearl St., Boston, Mass.

GROUND CLAMPS.

"Bossert" Ground Clamp. A one-piece, malleable-iron device for use on combination gas and electric conduit outlet boxes. Approved Oct. 5, 1908. Manufactured by

Bossert Electric Construction Co., Utica, N. Y.

"Stevens." A two-piece adjustable copper ground clamp made in two sizes. (a) For ½ to 1 inch pipe. (b) For 1¼ to 2 inch pipe. Approved Aug. 11, 1908. Manufactured by

Stevens Mfg. Co., Woodbury, N. J.

PANEL-BOARDS.

"Post-Glover," 2 and 3-wire panel-boards, 125, 125-250, and 250 V. All standard types, branch circuit with open link, Edison plug, or cartridge enclosed fuse cut-outs with or without double-pole knife or snap switch, with or without main-line knife switch and fuse cut-out. Approved Oct. 6, 1908. Manufactured by

Post-Glover Electric Co., 314-316 W. Fourth St., Cincinnati, O.

RECEPTACLES FOR ATTACHMENT PLUGS.

G. E. cleat and flush types of receptacles with "pull-off" attachment plugs, 6 A., 250 V. Cat. Nos. 49,488 and 49,490, respectively. Approved Aug. 11, 1908. Manufactured by

General Electric Co., Schenectady, N. Y.

"Bryant" Surface Attachment Plug and Receptacle, 25 A., 250 V., Cat. No. 340. Also sub-base for use with this device with wooden molding. Cat. No. 344. Approved Aug. 10, 1908. Manufactured by

INDUSTRIAL

THE MANUFACTURE OF FIR CROSS ARMS.

By A. T. CROSBY.

HAVE you ever leaned back in your comfortable seat in the Pullman, your magazine or novel finished, and idly gazed at the passing landscape? Mountains, valleys, farms, woo s and fields—factories, churches — rivers, lakes and bridges pass quickly in review, leaving but faint impression on the eye and still less on the memory.

And throughout this panorama, always in the foreground, yet so common and accepted as to be taken but as part of the scenery, stretches mile after mile of poles, wires, insulators, cross-arms, the instant transmitter of messages of good and bad fortune, business, society, births, deaths, news, items from all over the world for to-morrow morning's paper— he annihilator of time and distance—the telegraph.

Primeval Fir Forest.

Have you ever thought of the time and labor and energy required to build and maintain the vast network of wires over the country so you can read every morning of what is happening on the other side of this earth of ours? Of the number of trees cut for poles? Of the iron or copper taken from the mines, smelted, hammered, manipulated in a thousand different ways and finally drawn into the miles and miles of wires on which the messages travel? Of the engineering problems solved, of the manual labor rendered—and mental resources exhausted simply in the original building of a telegraph or telephone line?

Take the simple matter of cross-arms—the "stick of wood" fastened to the pole which supports the wires—surely no special care is required for them? Any piece of lumber will do—just go to a lumber yard and buy it. Not so. The cross-arm must be hard as iron, yet metal will not answer the purpose; durable as granite; have the tensile strength of steel, and be able to withstand the corrosive action of weather conditions and the strain of storm, sleet, wind, and water, to say nothing of the constant pull of tons of wire stretched tightly, and in constant vibration. Cross-arms must be practically "clear" (free from knots that would weaken their power to resist strain); straight-grained; of material that is hard, elastic and durable, and must be of perfect manufacture or they will give way at a time when their service is most needed. The manufacture of cross-arms is a business in itself, for which experts of long experience are required, and in which vast amounts of money are invested every year. It is estimated that something over five million cross-arms are purchased annually, amounting to about sixty million feet, board measure, of lumber. Of this amount about forty per cent comes from the Pacific Coast forests, about twenty per cent from the Southern Atlantic States, twenty-five per cent from the yellow pine forests of the Gulf States, and fifteen per cent from the fast receding Michigan and Northern lumber camps.

More than one-half of the entire output goes to the telephone companies of the country, about one-quarter to the telegraph companies and steam railways, and the balance to electric railroads, light companies and power plants.

Nothing but the very best of material and highest-skilled workmanship must go into a cross-arm. For this reason, perhaps, their manufacture is confined to a very few large concerns, who from long experience thoroughly understand what is required.

The largest manufacturer of cross-arms in the world is the Walworth & Neville Mfg. Co., who have mills in Washington, Mississippi, Virginia, Michigan and Minnesota. They have made a specialty of the manufacture of cross-arms for the past thirty years, and have brought their output to a standard that, while it meets the requirements of the consumer, tends to discourage the ambitions of other lumber dealers from attempting to participate in the very slight margin over the prevailing price of rough lumber at which cross-arms are sold.

Three other concerns who devote a part of their energy to the manufacture of cross-arms, although to a smaller extent, have their mills in Washington, and are the McCormick Lumber Co., the Eastern Ry. & Lumber Co., and the Doty Lumber and Shingle Co.

From time to time experiments have been made in the past fifty years at considerable expense, to institute the use of iron or other metal for cross-arms, but so far without success. The electric current will "short-circuit" on the slightest provocation, and a metal cross-arm is too much of a temptation.

Careful investigation and the result of many tests given by the engineers and experts engaged in the construction and maintenance of telegraph and telephone lines, has pretty

conclusively demonstrated that the best material for use in the manufacture of cross-arms, is the Douglas or Washington fir, which grows only on the Pacific Coast, in Washington, Oregon, and North in Vancouver, B. C.

Fir is a hard, tough wood, very straight-grained and very close-grained. The trees grow to from ninety to one hundred and fifty feet in height (and sometimes to two hundred feet) before branching; hence the lumber runs largely to "clear"—free from any large knots—a condition very essential in cross-arms. Fir has a great tensile strength—far more than sufficient by actual tests to stand all the special strain to which cross-arms are subject. The closeness of the grain prevents dampness getting into the pores of the wood and starting decay, and there is no excess of natural sap to effervesce and lead to "dry rot" or to exude under the rays of a hot sun, leaving the wood porous and weak, as is so notably the case with the Southern or yellow pine. For these reasons fir is exceedingly durable—not subject to action of weather conditions, and there is a saying among the telephone companies of the Middle West that "Fir cross-arms last as long as the poles to which they are attached."

As a matter of fact, there is practically no limit to the length of time fir will remain stout and strong even under the most adverse conditions, as possibly the following will show:

Taking Fir Logs to the Mill.

Scattered through the forests of Washington are gigantic trees that fell ages ago and have been buried in moss and decaying vegetation for generations. The moss upon these fallen monarchs has provided a bed for the seeds of other trees, and those seeds have sprouted, taken root and grown, and covered the fallen trunks with their roots. Such an instance was found not long ago in the forests of the Walworth & Neville Mfg. Co., where the tree which had originally fallen has three hundred and twenty rings, and the tree which had grown over it and covered the old trunk, was found, when cut down, to have seven hundred and forty rings. If it is a fact that every ring denotes a year's growth then the first tree had fallen and ceased growing three hundred and twenty-five years before America was discovered. It was lying, covered with moss, at the time that Richard I, "Coeur de Lion," was knocking at the gates of Acre, centuries before the burning of Joan of Arc, or the death of Willam Tell, yet the **lumber in this old tree was sound,** and was cut up into boards and shingles, a sample of which is on exhibition in the Chicago office of that company to-day.

Of course, the company does not give a written guarantee that its fir cross-arms will last for over seven hundred years, but with the above in mind it looks as though they might possibly be justified in doing so.

The records of the Forestry Service do not trace this Washington fir back of its growth on the Western coast of the American continent, but from its similarity of growth, fibre, strength and durability of its timber, shape and general nature of the growing tree, there is very strong reason to believe that the fir of the Northern Pacific Coast is closely related, if not the direct descendant of the Cedar of Lebanon, of which King Solomon made use in the building of the temple at Jerusalem.

It is perhaps a "descent" in more than one sense of the word for this monarch of the forest, from being used for the decorative ceiling work and vast trusses of one of the most magnificent buildings ever erected, to becoming simply a support for the stringing of wires, yet who shall say that in thus entering into and becoming a part of an intricate system whereby is evolved a means of intercommunication between all parts of the world, overcoming the limitations of time and space, and bringing the Tribes and Nations into accord and intimate knowledge of each other, that the fir of America is not fulfilling as noble a destiny as its ancestor the Cedar of Lebanon?

But it is not only in the proper selection of material, nor even in the quality of that material, that special attention must be given to the manufacture of cross-arms. Many a lumber manufacturer has gone broke in the endeavor to establish a cross-arm business, before he has learned that after the log has passed through the sawmill and the lumber been cut to proper dimensions, there is from twenty-five to thirty per cent waste in the cutting of cross arms from that lumber. Imperfections must come out; checks, knots, "pitch pockets," cross-grained patches—all these must be cut away; and from what is left the cross-arms must be cut to exact size and length. A piece nine feet eleven and one-half inches long will not do for a ten-foot arm, but must be cut down to the next length—eight feet—and that means over two feet of lumber lost.

Again, if, when the lumber is going through the sawmill, the big saw should slip, and cut the pieces just the merest trifle "scant" (as quite often happens), it must be thrown aside, for no cross-arms under full size will be accepted for use. After being cut to dimensions and length, the arms must be planed on four sides, rounded or "chamfered" on the top, and bored with holes for the wooden pins which hold the glass insulators on which the wire is strung. These holes must be exactly at right angles to the arm, and of exact size. If the least bit large, the pins will "wobble" and will be insecure, while, on the other hand, if the blade of the augur be a little dull, and the finish of the hole rough instead of smooth and clear, the pin will not go into the hole unless

driven with a hammer, and this at least tends to split the arm right at the outset of its work.

Then there is the question of seasoning. "Green" lumber will not do for cross-arms. Many a carload has been rejected at destination, because, although they left the mill straight and square, and apparently perfect, yet the material had not been thoroughly seasoned before being manufactured, and the heat of the close packing in the car had already caused the arms to "sweat" and twist and warp, until they would hardly be recognized as the same arms which had gone into the car. However, this test of examination upon arrival at destination is but the first of a series to which the cross-arm must be put during its entire life. Every good telephone or telegraph line is kept under constant surveillance day by day, repairs made, defective parts replaced, and the line kept in perfect order, and if any of the cross-arms show evidence of "dry rot" or other weakness, they are at once replaced. Yellow pine cross-arms are supposed to last from five to six years, and fir arms "as long as the pole," so that if, by reason of lack of proper seasoning, or other defect in manufacture, a line of cross-arms is found to be weakening before their proper time, a heavy expense is entailed for their replacement, and the first question asked is, "Who supplied those cross-arms?" and then the command, "Don't buy any more from that factory." This caution is absolutely necessary, for one weak cross-arm giving away, especially during a heavy wind or sleet storm is liable to carry the whole line with it, sometimes for a long distance. Or if it should break while one of the linemen was sitting on it, repairing or replacing the wires, the company would "be in for" a damage suit that might run up to thousands of dollars.

Hence the necessity for the manufacturer, in his own interest, to take every possible precaution to have the cross-arms perfect in every respect before they leave the factory. Fence rails will not answer for cross-arms, any more than fence wire will suffice for line construction, or pop bottles for insulators. It costs a vast amount of money for the original investment, and a continuing expenditure of enormous sums to enable us to "call up" our friends or business connections, or to send a message across the country and get an immediate reply "over the wire."

TRUMP TURBINE INSTALLATION.

Muralt & Co., of New York, have secured the contract for the enlargement and improvement of the hydro-electric plant of the Riverhead Electric Co., of Riverhead, L. I. The old water-wheels now in use will be taken out and new Trump turbines of the vertical shaft type will be installed. The electric equipment will be of the three-phase alternating current type with a frequency of 60 cycles per second and 110 volts. There is also an auxiliary steam plant for emergency purposes.

The G. M. McKelvy Co., of Youngstown, Ohio, have placed an order with the Nernst Lamp Co. for the new Westinghouse Nernst lamps, for the entire lighting of their new four-story store building, to be occupied this month. The installation will consist of thirty-six three-glower lamps for the first floor, sixty-nine two-glower lamps for the second and third floors, and seventy-five 132-watt lamps for the basement and fourth floor. This is the largest department store in Youngstown. The building now occupied by the McKelvy Co. has been lighted by the old-style Nernst lamps for several years.

GASOLINE ENGINE AUXILIARY TO ELECTRIC MOTORS.

The new Scherzer bascule span at Cleveland, O., was built this year by the New York, Chicago & St. Louis Railway, across the channel of the Cuyahoga River, at Cleveland, O. The viaduct has a total length of nearly 3,000 feet, and about 60 feet high. The rolling lift span across the river channel being 70 feet above the water. This bascule span is a double track single-leaf throughout bridge, 160 feet long, center to center of bearings, and 29 feet 6 inches wide, center to center of trusses. The clear channel for navigation allowed by the new bridge is 120 feet, measured at right angles to the channel, the bridge crossing the river at an angle of about 62 degrees.

The bridge is operated by two direct current electric motors of 50 horse-power each. There is also a 9 horse-power Fairbanks-Morse gasoline engine auxiliary, to operate the bridge should there be any trouble from defective current or electrical equipment. This 9 horse-power engine will lift the bridge in twelve minutes, doing the work of two 50 horse-power electric motors in case of a break-down.

BUREAU OF AMERICAN MANUFACTURERS.

To fill a need of American manufacturers for better facilities abroad a "Bureau of American Manufacturers in Europe" has recently been organized. This Bureau has leased a large six-story building in the business heart of London, England, and foreign buyers visiting that city will be invited to attend the exhibition of American goods which will be carried permanently. A monthly bulletin will be sent to buyers in every quarter of the globe, personal letters will be dispatched to them at frequent intervals, and every mode of advertising consistent with progressive business methods will be employed to make the exhibit a profitable enterprise for the members participating.

A staff of experienced salesmen will be engaged, possessed of mechanical education in the lines to be demonstrated; writing rooms and private conversation rooms will be maintained, and buyers will be served as carefully and as thoroughly as would be possible at the home offices of the respective members. A comprehensive system of reports between Europe and America will keep the members in close touch with foreign conditions, and it is anticipated that a large increase in exports will attend this new movement.

TRADE CATALOGUES.

The Sprague Electric Company, New York, is sending out circulars Nos. 432 and 433. No. 432 illustrates a new line of fittings for use with its well-known make of flexible steel conduit, and No. 433 describes the new single strip type of flexible steel conduit designed especially for fireproof building.

Catalogue No. 4, from the Belden Manufacturing Company, of Chicago, Ill., is an exceedingly compact and complete illustrated price list of all kinds of electrical wires, cables and cordage. It includes many special wires not usually listed. There are also twenty-five pages of wire tables, and formulas useful in the design of electromagnets, resistance coils, cables, etc., much of which is original and all of which is arranged in convenient form.

Catalogue B-18 from the Benjamin Electric Mfg. Co., of Chicago, New York, and San Francisco, is a reference book on Benjamin Wireless Clusters and Lighting Specialties in which the convenience of the user has been kept primarily in mind. After illustrating the details of cluster bodies, it takes up ceiling, pendant, special and weatherproof fixtures, concluding with miscellaneous materials. Within these divisions the particular articles are listed in logical order, together with descriptive engravings, and brief explanatory texts. Thus a new catalogue retaining the essential features of the old, but more attractive in content, more comprehensive in scope, and more accessible in form, is offered the trade.

NEWS NOTES

WATERWORKS.

TONOPAH, NEV.—Water is to be piped from Klondyke Wells to the new town of Gold Reef, where a distributing system will be put in.

YERINGTON, NEV.—The City Council has passed an ordinance granting a waterworks franchise to F. W. Fairbanks and associates.

ROOSEVELT, ARIZ.—A new pipe line and distributing system for drinking and fire purposes is to be put in by the school department here.

TONOPAH, NEV.—The Lodi Mining Company of this place is starting the work of laying about four miles of water pipe to bring water to the mining property.

SANTA BARBARA, CAL.—Lee M. Hyde, engineer, has completed the preliminary survey for a water pipe line from the south portal of the municipal water tunnel to the Mission Ridge.

SAN DIEGO, CAL.—Preparations are now being made by the city water department to begin work early this week on the new water main and laterals on Third Street from A to K.

NEWMAN, CAL.—The Board of Trustees has received an estimate to the effect that the pipe line required by the proposed Orestimba water system would cost in the neighborhood of $5000 per mile.

CARSON, NEV.—The State Board of Capitol Commissioners has awarded to J. S. Burlingame & Co. a contract for a pipe line to be laid from the State reservoir to various State institutions. The bid was 26 cents per foot.

YUBA CITY, CAL.—Everything is now in readiness for the reception of bids for the new city waterworks. The entire piping system down town will be provided with newer and larger pipes capable of standing a greater pressure.

LOS ANGELES, CAL.—Sealed bids will be opened on November 2d for oil switches and transformers for use in the construction of the Owens River aqueduct. On the same date bids will be opened for four 24-inch hub end gate valves.

SAN FRANCISCO.—The Board of Public Works has called for bids to be opened November 18th for fire system power stations, pumps and turbines for the municipal auxiliary water plant, the total estimates for which amount to $257,000.

LOS ANGELES, CAL.—The Board of Public Works has awarded contracts for the Owens River aqueduct work as follows: To H. R. Boynton Company and to the Crane Company for water pipe and casing. A number of bids for other material have been opened but the awards have not yet been made.

SAN FRANCISCO.—The Board of Works of this city has been instructed to advertise for bids for the construction of four cisterns for the auxiliary water system. These cisterns are to be located as follows: At the corner of Laguna and Fulton Streets, corner Sutter and Octavia Streets, corner Van Ness Avenue and Washington Street, and at the corner of Van Ness and Golden Gate Avenues. The bids for these will be opened on November 2d.

OIL.

FRESNO, CAL.—The Imperial Oil Company has deeded to Charles G. Wilcox and John Culter, Jr., forty acres of oil land in this county subject to an easement granted to the Standard Oil Company last April.

SANTA MONICA, CAL.—Agents of the Associated Oil Company have been in the field here seeking for rights of way for a pipe line which will enable the company to bring oil from its new field in the vicinity of Sawtelle and Beverly to the Coast at this point.

SANTA BARBARA, CAL.—Exploitation of a new field seventeen miles north of this place is to be started shortly by the Sapphire Oil Company recently organized in Los Angeles with a capitalization of $1,500,000. The same company will also develop oil land in the Kern River district.

RENO, NEV.—James Nevin has returned from the Wellington and Wabuska oil districts and reports that a great deal of drilling is being done in both sections. Already sixteen oil locations have been filed on that portion of the Wellington district that is in Douglas County. Oil-bearing sands have been struck in several cases.

STOCKTON, CAL.—The Standard Oil Company has placed two well-boring rigs in operation in San Joaquin County, and the San Joaquin Oil Company has put one rig in operation on land sub-leased from the Daisy Oil Company. The latter company now has a well down 1500 feet and has bonded a strip of land two miles wide and fifteen miles long.

COALINGA, CAL.—The Kern Trading & Oil Company has installed a first-class dripping plant at this place. Three joints of pipe are handled at the same time. The American Petroleum Company reports having struck good sand at 1945 feet. The well is now producing about 400 barrels of oil per day and is yet to be finished. The British Consolidated Oil Corporation, Ltd., has its consulting engineer, Arthur W. Eastlake, in the field laying out work for the thorough deve' opment of the various properties the company has taken over G. W. Warner, superintendent of the Golden Crest Oil Company, has returned from the East and will drive this company's well to completion as soon as possible.

FINANCIAL.

SAN FRANCISCO, CAL.—The Imperial Water Company will hold a special stockholders' meeting on October 31, to take action on the proposition of increasing the capital stock of the company.

SALINAS, CAL.—The Eureka Consolidated Oil & Development Company has levied an assessment of two and one-half cents per share on the capital stock of the company, delinquent December 5th.

SAN DIEGO, CAL.—The City Council has passed an ordinance accepting the bid of the Merchants' National Bank of $198,891.45 for the water extension and enlargement bonds recently advertised for sale.

LOS ANGELES, CAL.—The September statement of the Edison Electric Company, of this city, shows that the gross earnings for that month were $206,548.95; the operating expenses, $107,223.80; net earnings, $99,325.15; fixed charges, $50,237.89; and surplus, $49,051.26.

PETALUMA, CAL.—The City Trustees have ordered the City Attorney to draw up an ordinance providing for the calling of an election to vote on the question of issuing bonds for the building of a high-pressure water system, for a municipal gas plant and for other municipal improvements.

TELEPHONE AND TELEGRAPH.

MODESTO, CAL.—A permit has been granted to F. C. Haldeman and others to construct a telephone line along the County Road, between Waterford and Hickman.

MODESTO, CAL.—Eugene McCabe has asked the Board of Supervisors for a permit to string a telephone line along the county roads in certain parts of the county.

AUBURN, CAL.—C. W. Longstaff and N. C. Longstaff, owners of the electric lighting plant at Forest Hill, have bought of the Pacific Telephone & Telegraph Company the Forest Hill telephone exchange and lines, and are making a number of changes and improvements.

TRANSPORTATION.

SAN FRANCISCO, CAL.—The United Railroads has begun work on the improvement of its Market Street line from Second Street out.

STOCKTON, CAL.—The Southern Pacific Company has begun a regular service with its new gasoline motors between Stockton and Galt.

RICHMOND, CAL.—The City Council has passed a franchise granting to W H. Rheer a franchise to construct a street railway in this city.

SANTA BARBARA, CAL.—The City Council of this place is advertising for sale a franchise for an electric street railway line. Bids will be received till November 13th.

SAN FRANCISCO.—A jury has awarded to the parents of Fucien Lafocarde a verdict of $3750 damages against the Geary Street Railroad Company for the death of Lafocarde, a minor.

MARYSVILLE, CAL.—According to the new time-table issued by the Northern Electric Company, there will, after November 1, be only three trains daily between Chico and Oroville.

ALAMEDA, CAL.—Edward P. Fish of this place has applied to the attorney-general of the State for permission to sue the Oakland Traction Company in the name of the State for the forfeiture of its franchise on San Jose Avenue and for $5000.

EL PASO, TEX.—The El Paso & Mesilla Valley Interurban Railway Company, recently organized here, has held several important meetings lately and has its work well planned. Preliminary surveys will be started at once. The company is capitalized at $1,000,000.

MODESTO, CAL.—The surveying corps of the San Joaquin Valley Railway Company has reached here, private rights of way having been secured for the entire distance between Stockton and this place. The company has now applied for electric trolley franchises in both cities.

SAN FRANCISCO, CAL.—The new turbine in the North Beach power house of the United Railroads will be in operation by the end of this week. This will give an addition of 10,000 horsepower, and will generate power for 100 more cars. Manager Black hopes to have 500 cars in operation shortly. Much of the congestion has been due to an accident in the power station of the California Gas & Electric Company in Visitacion a week ago, tying up its entire system.

ILLUMINATION.

MARYSVILLE, CAL.—J. N. Jensen, a natural gas expert of Stockton, who was brought here to investigate the indications for natural gas here, reports that the indications are only partially favorable. He says that experiments to settle the matter definitely would cost in the neighborhood of $20,000.

SAUSALITO, CAL.—An important meeting of the Marin Gas Company was held a few days ago, at which plans were laid for the work of the company. The company has begun surveys for the construction of a $45,000 gas plant at Sausalito, and it is estimated that nearly $100,000 will be spent in the construction of the plant and the piping of the town. A 1,000-000 cubic feet tank will be put in.

REDLANDS, CAL.—The Redlands Home Gas & Lighting Company, of this place, has commenced the construction of a high-power electric line from this city to Colton, and is planning to begin lighting that place by December 1st. The city authorities of Colton are questioning the validity of the franchise and contract which the company holds, and it is understood that litigation will result from the company's endeavor to enter the town.

SAN FRANCISCO, CAL.—The artificial lights committee of the Supervisors has received a communication from the Haight Street and Ashbury Heights Improvement Club, asking if the city would furnish lights for the ornamental poles which the club proposes to erect at its own expense in its district. In reply it was stated that the committee could not promise anything for the present fiscal year, but would bring the matter before the Board, with a request that a definite line of policy be agreed on as to making special arrangements for furnishing light current to districts where the residents provided ornamental poles.

INCORPORATIONS.

SAN FRANCISCO.—The Lava Bed Power Company has been incorporated here with a capital stock of $100,000 by R. Cadwalader, R. Arthur and F. McArthur.

STOCKTON, CAL.—The San Joaquin Valley Electric Railway Company has filed articles of incorporation here, the incorporators being M. L. Brackett, H. C. Holmes, H. E. Tier, J. G. Wier, E. T. Zook and G. E. Weber.

LOS ANGELES, CAL.—The Cousins Oil Company has been incorporated at Hollywood with a capital stock of $100,-000 by T. A. O'Donnell, M. L. McCray, E. J. McCray, A. M. McCray and L. A. McCray.

LOS ANGELES, CAL.—The United Electric & Hardware Company has been incorporated with a capital stock of $1,000,-000 by K. B. Cass, A. K. Fierce, J. H. Lowe, A. W. Brode and L. D. Brode. Mr. Cass is president of the Los Angeles Home Telephone Company.

SACRAMENTO, CAL.—The Mohave Water & Power Company has been incorporated here with a capital stock of $20,000,000, by Julien Mathieu, Harry C. Mack, C. F. Metter, of Oakland; F. C. Van Deinse, of Berkeley; and C. S. Goodrich, of San Francisco. It is understood that the company has been incorporated for the purpose of constructing a long-talked-of reservoir and power plant at Victor Narrows, in San Bernardino County.

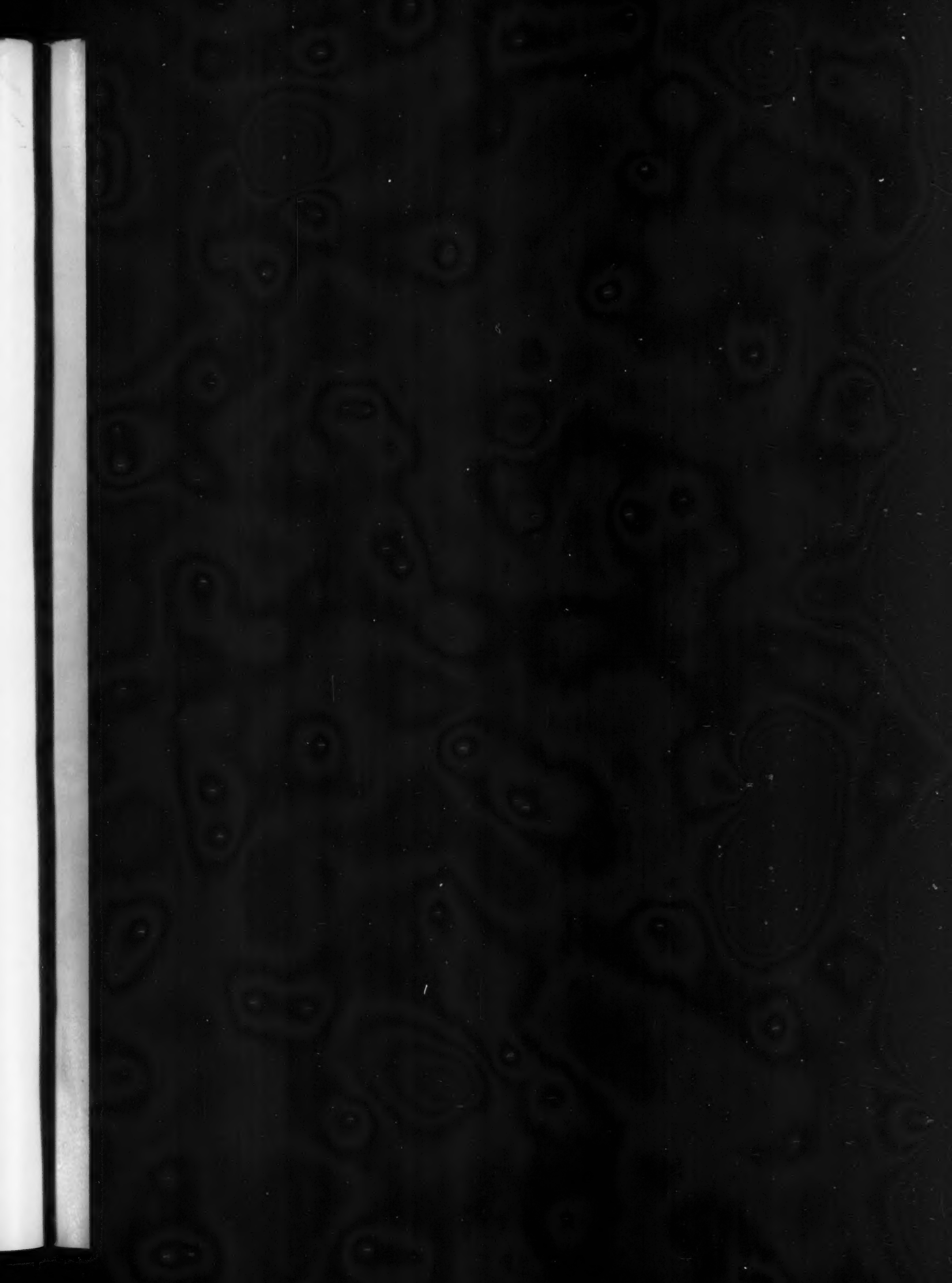
GREAT FALLS, MONT.—The Great Falls Power & Townsite Company has been incorporated for the purpose of erecting a large power plant which will, among other things, supply electric energy to the Chicago, Milwaukee & St. Paul Railroad. The company is incorporated with $5,000,000 capital, and the expenditures already planned involve about $4,000,000. One hundred miles of transmission line, requiring 4,000,000 pounds of copper wire, will be strung.

TRANSMISSION.

PARRAL, MEX.—The Guanecevi Tunnel Company, of this place, is planning to put in a power plant and air compressors at its works.

HEALDSBURG, CAL.—The City Trustees are advertising for bids for the furnishing and installing of a pipe-line to carry additional water to the municipal power house.

LOS ANGELES, CAL.—The Board of Public Works is advertising for bids to be received till November 16th, for eighteen step-down transformers and the necessary hydraulic and electrical machinery for the additional unit for the Cottonwood Creek hydro-electrical plant.

LOS ANGELES, CAL.—The following awards have been made by the trustees of the Soldiers' Home: To Foulks-Gaylord Company, of Los Angeles, installation of a dynamo in the power house, $1,128; to Fairbanks, Morse & Co., electric motor, $324, and for other items.

LOS ANGELES, CAL.—The Board of Public Works has awarded contracts to the Westinghouse Electrical & Manufacturing Company, for electrical locomotives to cost $31,000, and to the California Electrical Company for motor generators and direct-current motors to cost $4,705, and to the California Electrical Company for cedar poles, insulators, cross-arms, etc., to the amount of about $11,000.